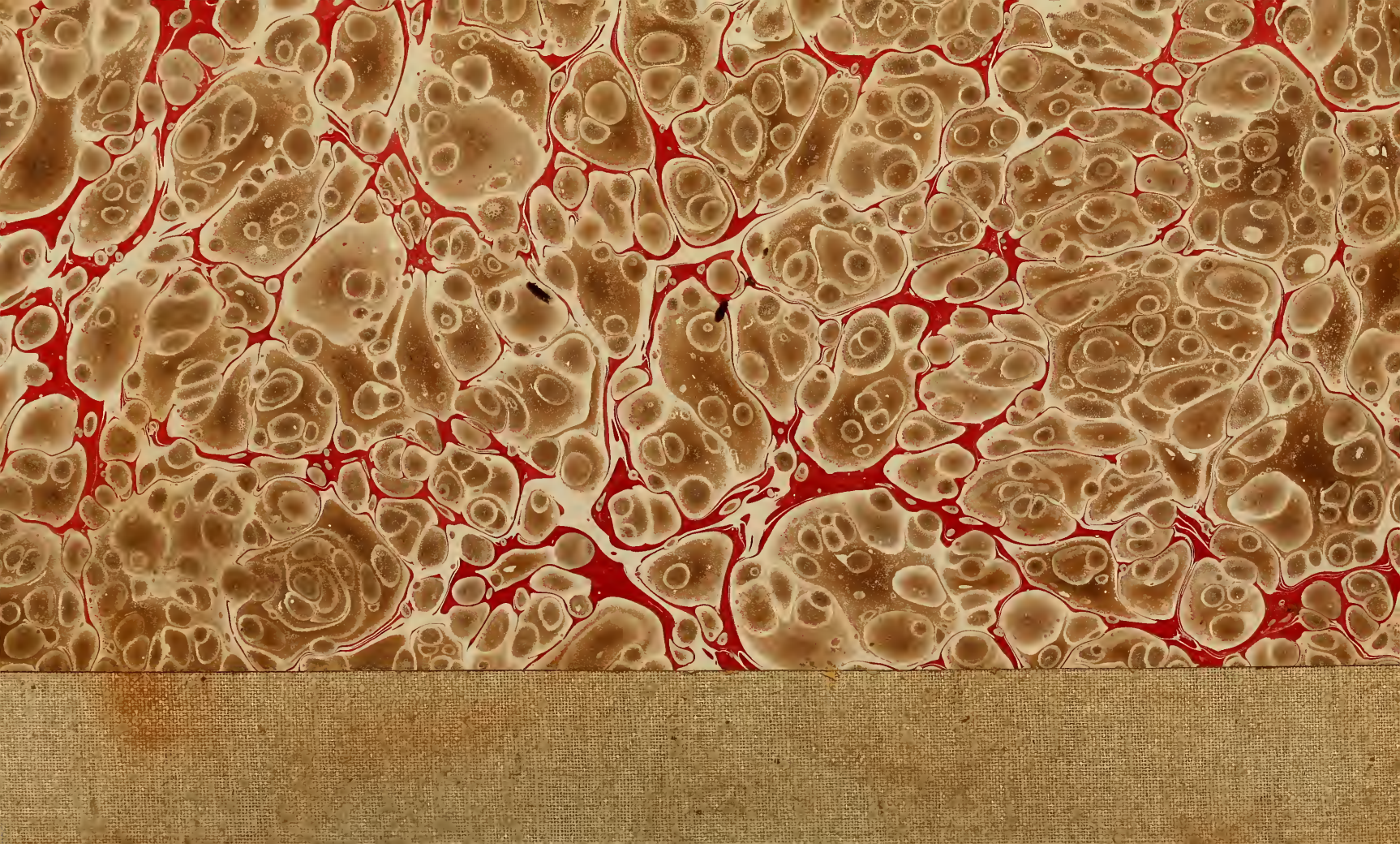

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SOME

OBSERVATIONS

RELATIVE TO THE

INFLUENCE OF CLIMATE

ON

VEGETABLE AND ANIMAL BODIES.

By ALEXANDER WILSON, M. D.

Utque duæ dextra cœlum, totidemque ſiniſtra
Parte ſecant zonæ; quinta eſt adentior illis:
Sic onus incluſum numero diſtinxit eodem
Cura dei, totidemque plagæ tellure premuntur.
Quarum quæ media eſt, non eſt habitabilis æſtu:
Nix tegit alta duas: totidem inter utramque locavit;
Temperiemque dedit, miſta cum frigore flamma.

OVIDII Metam. fab. ii.

LONDON:
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MDCCLXXX.

13269 1— Wash.

TO

WILLIAM CULLEN, M. D.

FIRST PHYSICIAN TO THE KING IN SCOTLAND,
AND PROFESSOR OF PHYSIC IN THE
UNIVERSITY OF EDINBURGH,
&c. &c. &c.

SIR,

THE marks of attention conferred on me when your pupil, the intimacy you have honoured me with ſince that time, and a deep ſenſe of the many acts of friendſhip I have received from you, all ſtrongly impel me to take this opportunity of acknowledging theſe benefactions.

Motives of this kind, with a certain degree of pride, have induced me to addreſs this ſhort performance to you, Sir, whoſe character as a Philoſopher, a Phyſician, and a Man, is not leſs admired by the votaries of ſcience, than beloved by the friends of ſocial virtue.

I am, with the greateſt ſincerity,

SIR,

Your moſt obedient and

Much obliged humble Servant,

ALEXANDER WILSON.

PREFACE.

IN perusing the following Observations, the Reader will readily perceive that most of them have been made in the warm climates; he will also see that the general scope of the whole is to shew the influence of climate on vegetable and animal bodies.

In the First Part I have endeavoured to prove, that a certain degree of the phlogistic principle is universally necessary to vegetation, and that the component parts of bodies are disengaged by putrefaction in a certain proportion to climate, which climate is always adequate to the re-application of the separated parts, to form new vegetables in the same proportion.

In the Second Part I have conſidered the human body as made up of vegetable matter, and poſſeſſing different powers and properties according to the greater or leſs affinity it bears to the vegetable kingdom.

I have alſo conſidered in what manner theſe different conditions of body are affected by different climates; and I have endeavoured to ſhew how the temperature and purity of the atmoſphere may either promote or counteract the effects of food; to which are added, ſome opinions founded on the principles laid down, relative to the ſcurvy, conſumption, and ſmall-pox.

A putreſcent tendency of body I have conſidered as a prevalence of the phlogiſtic principle. By this I do not mean to ſay, that the ſame body contains more phlogiſton when in a putrid ſtate, than when in a ſound one. By putreſcent tendency relative

tive to phlogiſton my meaning is, that as all bodies are decompoſed by putrefaction, and the phlogiſtic principle thereby ſeparated from them, the ſame body will evolve this principle more copiouſly in proportion as the degree of its putreſcent tendency is increaſed.

In the Third Part I have conſidered the effect of a putreſcent ſtate, in altering the external appearances of the human body, and changing or ſtupifying the powers of the mind. I have alſo endeavoured to ſhew how thoſe effects reſult from both hot and cold climates; and from theſe principles I have drawn ſome concluſions relative to ſlavery and freedom in different countries; but as this leads to diſcuſſions foreign to my preſent plan, I have gone no further than what ſeemed to be neceſſary to ſhew, that the real ſtate of facts corroborates the theory laid down.

I have endeavoured to compriſe theſe Obſervations within narrow limits. It may perhaps be thought that brevity hath been too much ſtudied; but I flatter myſelf that an accurate attention to the connection which the different Chapters and Parts have with each other, will make my meaning diſtinctly perceived through the whole.

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ERRATA.

Page 4, line 13. Place the Comma at *inhaled*, and not at *pure*.
28, l. 17. For *chapter*, read *chapters*.
29, l. 3. For *alleged*, read *objected*.
55, l. 12. For *them*, read *it*.
65, l. 13. For *these bodies*, read *the sun and moon*.
127, l. 7. For *prevent* read *prevents*.
156, l. 7. For *poisons*, read *animal poisons*.
177, l. 3. For *are fitted*, read *are so much fitted*.
209, l. 16. For *its action to both*, read *its action both*.

PART I.

Of the Food and Circulation of Vegetables.

CHAP. I.

The Object of this First Part.

ON taking a general view of the earth, it will readily be allowed that vegetation in every part of it bears a certain general proportion to the Sun's influence, from which we are naturally led to consider him as the grand source of vegetable life; and although this conclusion must be admitted, yet to trace the manner of his action is a matter of enquiry. We mean,

therefore, in the following chapters, to attempt ſhewing that heat, by accelerating putrefaction, diſengages the component principles of bodies from each other, and that by the joint action of the ſun and moon theſe ſeparated parts, or principles, are re-united, and differently combined in the various forms which compoſe the vegetable kingdom.

CHAP. II.

Air neceſſary to Vegetation.

NO plant will thrive *in vacuo*, and vegetables of all kinds receive from the atmoſphere matters of ſuch quality as are neceſſary for their vigorous growth, and by its aſſiſtance diſcharge their perſpiration according to their different natures, and climates in which they are placed.

A plant kept in a dry and pure air ſoon becomes languid, though regularly watered at the root: this is a proof that pure water

and pure air, alone, will not promote a healthful and vigorous vegetation. The evident change which takes place in plants ſo circumſtanced, after the fall of a warm refreſhing ſhower, is full proof of their having got ſomething beſides moiſture at the root.

Gardeners know that moiſtening the leaves, ſtems, and roots of plants with pump or river water will not anſwer, inſtead of natural rains, which in their deſcent through the atmoſphere bring down ſome other ingredients neceſſary to vegetable increaſe.

CHAP. III.

Of the Ingredient in the Air neceſſary to Vegetation.

IT is a well-known fact, that air which hath been reſpired by animals is rendered unfit for the continued reſpiration of the

ſame, or any other animal, by being loaded with phlogiſton. Dr. Prieſtley hath ſhewn, that when this air is deprived of its over-charge of this principle, it is again fit for reſpiration: his experiments, with thoſe of Dr. Ingenhouſz, have alſo made it evident, that plants retain it as a proper and healthful food, which they abſorb with the common atmoſpherical air, and that the action of vegetables, expoſed to the light of the ſun, fits that fluid again for the purpoſes of animal life, by diſcharging the impregnated air they inhaled in a pure, dephlogiſticated ſtate *.

The air which is detached from putrid vegetable and animal ſubſtances ſeems only improper for reſpiration by the quantity of phlogiſton it contains; conſequently as that which renders air noxious to animals makes

* See Ingenhouſz' Experiments on Vegetation, page 43.

it

it ſalutary to vegetables, we ſuppoſe it is this principle contained in natural rains which ſo much increaſes the growth of plants.

It is this phlogiſton that gives a particular ſulphureous ſmell, ſometimes obſervable even in this country after long droughts in the heat of ſummer, which reſembles the air of a room highly impregnated with electric matter. In the tropical latitudes this ſmell is often ſo ſtrong as to become very diſagreeable, particularly when the rains ſet in after a conſiderable duration of dry weather.

Phlogiſton hath an affinity with water*, and alſo with the air contained in water, which promotes their union in the atmoſphere, either in its deſcent, or when ſup-

* See Prieſtley on air infected with animal reſpiration, vol. 1. p. 180.

ported in the form of vapour, which being condenſed into rain, and falling on the ſtems and foliage of plants, is abſorbed by them, and makes a principal ingredient in their compoſition: what eſcapes contact in this way ſinks into the ground, and is probably taken up by the roots of the plant.

From this view it is evident, that differently impregnated atmoſpheres muſt affect vegetation very differently, and from this cauſe ſeems to ariſe the ſuperior fertility of lands cloſe to great towns, with leſs manure and labour than thoſe of the ſame quality at a greater diſtance from ſuch places of warmth and putrefaction, by which the diſſolution of bodies is accompliſhed, and that phlogiſton diſengaged which impregnates the ſurrounding atmoſphere.

The air of the Sugar Iſlands is ſo highly replete with this principle, that many plants

of

of quick growth, which have very few roots attaching them to the ſoil, are ſupported by it; the *no root*, a vine of rapid growth, has not the ſmalleſt hold of the ſoil, and a part of it cut and flung on any old wall, or tree, will vegetate vigorouſly, if in a warm and not over-dry ſituation.

CHAP. IV.

Probability that Phlogiſton and Electric Matter are Modifications of the ſame Principle.

THE particular countries in which vegetation is moſt quick are the warmeſt, and moſt productive of putrefaction; where growth is leſs quick, putrefaction is in proportion ſlow; and we ſhall find that the quantities of lightning in different countries keep pace with the progreſs of putre-

faction in them, the rapidity of which is in proportion to the warmth, when the ſurfaces of the countries are under equal circumſtances.

Lightning is more abundant and frequent in Surinam, Iſaac-cape, the Spaniſh main, and ſouthern parts of America, than in countries equally woody in more northern latitudes, where the heats are leſs: theſe countries are famous for the rapidity of their vegetation, and the quick progreſs of putrefaction.

In the northern regions, about Groenland, there is ſcarce any lightning after ſummer*; although it is warm in the day, yet the cool evenings check the progreſs of putrefaction reſulting from the ſun's heat.

* The account of Mr. John Egede, a Daniſh miſſionary ſettled in Groenland fifteen years.—Harris's Collection of Voyages.

In

In Nova Zembla, ſtill further north, thunder is ſcarce known. In the former of theſe countries there is a little vegetation, but it is confined to few plants, and that only for a very ſmall part of the year; putrefaction is there in proportion ſlow. In the latter place vegetation is much leſs, and putrefaction in dead matter ſcarce proceeds at all in the open air.

In our own climate, when the weather is warm, cloſe, and ſultry, putrefaction goes on rapidly, and vegetation is vigorous in proportion. In ſuch an impregnated ſtate of the atmoſphere lightning is moſt common while reſpiration becomes heavy and oppreſſed, in proportion to the phlogiſticated ſtate of the air.

The great quantities of lightning in hot countries ſeem to ariſe from the quick diſſolution of bodies, by which the phlogiſtic principle

principle is diſengaged. In the middle of the Atlantic ocean lightning is ſeldom ſeen; but as we approach the above-mentioned continents, it becomes more and more frequent. This a fact well known to ſeamen, which renders it further probable, that the ſame phlogiſton which made a part in the compoſition of bodies, is lightning when diſengaged from them. As an ingredient in the compoſition of plants, its quantities muſt not only keep pace with the decompoſition, but alſo tend to promote vegetation in the ſame proportion*.

* Mr. Henly ſuppoſes fire, phlogiſton, and electric matter, the ſame principle, differently modified. Mr. Cavallo conſiders fire and phlogiſton the ſame, and points out ſome differences in the effects of fire and electricity; yet in concluſion he joins with Mr. Henly in thinking it highly probable that all the three are only modifications of the ſame principle.—Cavallo on Electricity, p. 115, 116, 117.

CHAP.

CHAP. V.

Of the Cauſes of Putrefaction.

HEAT hath generally been conſidered as the ſole cauſe and promoter of putrefaction, and may therefore be called the grand ſeptic principle of nature, as, without a certain proportion of it, none of the fermentations will proceed in any degree whatever.

Although heat is abſolutely neceſſary to the progreſs of putrefaction, yet that proceſs is exceedingly accelerated by phlogiſton and lightning; and we ſhall find by the following experiments, that the contact of the lunar rays alſo very much promotes it.

About the latitude of 11 degrees north, in the month of February, a thin piece of freſh

freſh beef, about four ounces weight, and perfectly ſound, was cut in two equal parts, and kept in the ſame temperature from mid-day to ſeven o'clock in the evening; one of the pieces was then covered with a box, which did not admit a particle of light; the other was ſpread open, and expoſed to a bright and full moon. They were both left in this ſtate till next morning, at which time the covered piece ſhewed not the ſmalleſt ſign of putrefaction, while the other ſmelt ſtrongly. By two o'clock the ſame day the ſound piece began to ſmell, but that which had been expoſed to the lunar rays was much further advanced in putrefaction.

Facts of this kind are ſo generally known in thoſe climates, that the fiſhermen, who are out all night, take care to prevent the rays of the moon from ſhining on the fiſh they catch; yet notwithſtanding their precautions, thoſe taken in moon-light become

come putrid conſiderably ſooner than others taken in the day-time, or when there is no moon-ſhine. For inſtance, two fiſh of the ſame kind, and nearly of the ſame ſize, were taken; one was killed about twelve o'clock in the day, and the other at ſeven o'clock in the evening; the firſt was put into a cellar from which the light was excluded, the laſt lay all night expoſed to the full moon: at ſeven o'clock next morning both diſcovered ſigns of putrefaction, and by two o'clock the ſame day that which was firſt killed ſmelled ſtrongly; while the other, which was killed ſeven hours after, and expoſed to the moon-light, ſmelled as ſtrong, and ſeemed more diſſolved.

Innumerable inſtances of a ſimilar nature to thoſe we have mentioned might be adduced, to prove that the immediate contact of the lunar rays does actually induce putrefaction with remarkable rapidity; and

that

that this effect follows from the actual contact of the lunar rays, and not from the atmoſphere, is undoubted, as no perceivable effects follow when the rays of the moon are excluded from contact with the animal matter.

We made various experiments to try if the contact of the lunar rays were productive of ſimilar effects on dead vegetable ſubſtances, but the conſequences were by no means remarkable. The ſlow progreſs of putrefaction in vegetable bodies, and the difficulty of keeping them in an equal ſtate of moiſture, made ſuch experiments tedious and uncertain.

CHAP. VI.

Effects of Moon-light on growing Vegetables.

BETWEEN the tropics, it hath been long a general opinion among thoſe concerned in the agriculture of thoſe climates, that moon-ſhine, or the contact of the lunar rays, ripens fruits, and accelerates the growth of plants. To aſcertain the truth of this opinion we made ſeveral experiments, and from the general reſult we are led to concur in its favour. As we found it impoſſible, without vaſt labour, to exclude the lunar rays from large vegetables, we confined our experiments to ſmall ones.

About a dozen young cabbage plants grew together in the ſame bed; ſix of them

of

of equal vigour with the reſt were covered up every night, ſoon after ſix o'clock, with a box which admitted no light, from ſix days after the change to ſix days after the full moon, and were uncovered every morning about, or ſoon after ſun-riſe, while the remaining plants were allowed a free expoſure to the rays of the moon.

Thoſe which were uncovered had evidently the advantage of the covered ones. The experiment was repeated with lettuces, and the advantage at the beginning was evidently in favour of thoſe put under cover, by way of equivalent for want of the nocturnal humidity; yet notwithſtanding, in two weeks, they were exceeded in ſize and beauty by thoſe which ſtood expoſed *.

* Even in this climate, the country people think that moon-light hath conſiderable influence in ripening the fruits of the earth.

This

This was a point rather too nice to be determined by the reſult of one or two experiments; we therefore concur in the general idea, from finding that every trial, and inquiry, tended more or leſs to prove the opinion founded on fact.

As putrefaction is undoubtedly accelerated in dead animal bodies by the contact of lunar rays, there is from that circumſtance great reaſon to ſuppoſe it will forward the growth of plants, as every ſeptic, we know, promotes vegetation, and every thing that promotes vegetation is more or leſs a ſeptic when applied to dead vegetable or animal bodies. Dr. Ingenhouſz has, by many curious and ſatisfactory experiments, proved that plants imbibe air in a phlogiſticated condition, and diſcharge it in a very depurated ſtate. This wonderful operation of plants on air he has ſhewn to depend on the action of light,

independent of heat, as in the ſame degrees of heat, without light, the vegetation of plants does not improve the quality of either noxious or atmoſpherical air. Theſe facts give us reaſon to ſuppoſe, that this property of moon-light may be very conſiderable, as it is the ſolar rays brought to us by reflection, though in ſo rare a ſtate as to be incapable of producing the ſmalleſt degree of heat by any concentration yet diſcovered.

CHAP. VII.

The Effect of Electric Matter in promoting the Growth of Vegetables, and the Putrefaction of Animal Subſtances.

THE Abbe Nollet has proved beyond a doubt, that electric matter, properly applied, accelerates the growth of vegetables;

bles; and, from what we have already mentioned, it is pretty clear that an atmoſphere charged with lightning hath the ſame effect on vegetables, and alſo remarkably accelerates putrefaction in animal bodies.

In the middle of winter we divided a ſmall fiſh into two equal parts along the back bone; the one half was kept in an electrified ſtate for ſome hours each day, while the other lay expoſed to the air in the ſame temperature: that which had been electrified emitted a putrid ſmell a conſiderable time before the other was affected. From this experiment it appears, that putrefaction is accelerated in animal ſubſtances by electric matter, and will in all probability be promoted in proportion to the quantity accumulated in it.

If therefore we admit phlogiſton, lightning, and electric matter, to be the ſame principle, it will operate in inducing putrefaction where it exiſts naturally in bodies, as well as where communicated from without, either by an impregnated atmoſphere or an electrical machine, under equal circumſtances of heat and moiſture.

The above facts tend ſtill further to increaſe the probability that phlogiſton and electric matter are the ſame; and we ſhall hereafter ſhew, that the putreſcent tendency in animal matters is proportioned to the quantity of this principle in their compoſition.

CHAP.

CHAP. VIII.

Why Lightning is leſs frequent, and Growth leſs luxuriant in the Weſt-India Sugar Iſlands, than on the Continents in the ſame Latitudes.

DR. Prieſtley hath proved, that contact and moderate agitation with water depurates phlogiſticated air, and, like vegetation, renders it fit for the purpoſes of animal life *.

Small iſlands retain but ſmall quantities of air, and the trade winds which blow continually over them are depurated by contact with the ſurface of a very extenſive ſea, by which they are enabled to unite with, and abſorb the phlogiſton diſengaged from bodies on the land, and carry

* See Obſervations on Air infected with Animal Reſpiration.—Prieſtley, vol. i. p. 95.—and Ingenhouſz, ſect. 4.

a certain proportion of it from theſe iſlands: hence lightning is leſs frequent, and vegetation leſs luxuriant in them, than on continents in nearly equal latitudes.

The difference between ſmall and large iſlands is alſo moſt evident; and even on the ſea-coaſt of the ſame iſland vegetation is ſlower, and lightning leſs frequent, than in the more interior parts, where the air is leſs agitated and more impregnated, by being leſs expoſed to the contact of the depurated ſea air.

CHAP. IX.

A Conjecture why on the South of the Equator, in equal Degrees of Latitude, it is much colder than on the North.

IT hath been an obſervation generally made by voyagers to the ſouth of the equator, that in the ſame degrees of latitude

tude the colds were conſiderably more ſevere, than on the northern hemiſphere.

As the fact is undoubted, the following conjecture ſeems to afford a probable explanation of it.

The different quantities of phlogiſton diſengaged by putrefaction in any two extenſive diſtricts of the globe, equally ſituated as to latitude, depends on the quantity of land in each diſtrict, its height and regularity of ſurface, and the manner in which it is clothed with vegetables, and ſtocked with animal bodies; and in whichever the ſurfaces are moſt flat, and theſe productions moſt abundant, the air will there be moſt highly impregnated, or phlogiſticated, and in proportion warm.

When we take a view of the ſouthern and northern hemiſpheres of the earth,

the land on the north is found equal to one half its whole ſurface, and the waters in many places are ſo interſperſed with it, that they may be conſidered as narrow inlets, over which the impregnated land air paſſes without being ſo totally depurated as in wider ſeas. Even the moſt extended part of the northern ocean has many conſiderable iſlands ſcattered through it, from the ſurfaces of all which vegetable and animal bodies are continually ſuffering a decompoſition by putrefaction.

To the ſouth, is an immenſe extended ſea, without any large bodies of land, except the capes of Good Hope and Horn, and the lands of New Zealand, New Holland, and New Guinea, all of which are not equal to more than one-fourth, or perhaps one-fifth part of the ſurface of the ſouthern hemiſphere. The firſt extends not far to the ſouth, is mountainous, and

narrow at its extremity: the ſecond of theſe capes is alſo very high land, and runs much further ſouth, but draws towards a point at its extremity, which is barren.

Theſe lands are ſituated at a vaſt diſtance from each other; conſequently the winds which are about them, and blow over them, are in a more depurated ſtate than ſimilar winds in equal latitudes on the north of the equator. New Zealand, New Holland, and New Guinea, are at too great a diſtance from the Capes of Good Hope and Horn to influence the temperature of the air about them. Secondly, the rays of the ſun, which fall on water, give no heat to that water, unleſs they meet ſome opaque body, by which they are reflected or retained. The ſame rays, ſo converged by a concave, or convex lens, that the focal point falls within the body of the water, communicates no heat to it; but if an opaque

opaque ſubſtance is introduced into the water, and the focal point made to fall on its ſurface, it will immediately be acted upon. Hence we may ſuppoſe a large proportion of the ſun's rays are loſt in the ſouthern hemiſphere, as all that are not reflected from the ſurface, but paſs into the body of the ocean, muſt loſe moſt of their power before they can be ſuppoſed to reach the bottom; whereas, in the northern hemiſphere, the large proportion of land affords a vaſtly greater ſurface of opaque matter for the reflection of the rays of the ſun.

If to theſe cauſes of cold we add that produced by evaporation from ſuch extenſive ſeas *, the fact will appear tolerably well accounted for.

* See Dr. Cullen on Cold by Evaporation.—Edinburgh Phyſical and Literary Eſſays.

Lightning

Lightning in the ſouthern hemiſphere is found leſs frequent than in the northern, which circumſtance renders the above ſolution ſtill more probable.

CHAP. X.

Effect of great and quick Changes of Climate on Vegetables.

PLANTS which are natives of cold climates, when removed to the torrid zone, ſoon become ſickly, probably from too phlogiſticated an atmoſphere, which ſupplies that principle too faſt for their powers of aſſimilation; that ſupply, with an over-perſpiration, and probably a want of veſſels adapted to abſorb with ſufficient rapidity to ſupport this great diſcharge, are the cauſes of their ill-health, which perſpiration we ſhall hereafter obſerve is the cauſe, and not the conſequence, of abſorption.

Thoſe

Thoſe of hot climates, carried into northern countries, have all their fibres contracted, and pores ſhut up, by the cold, which diſables them from diſcharging their perſpiration; therefore abſorption is prevented, and matter for vegetation being leſs abundant in ſuch an atmoſphere than in their native climate, they die from languid circulation and want of food. And we ſhall hereafter endeavour to ſhew, that the circulation of the vegetable kingdom keeps pace with the actual and natural ſupply of food reſulting from climate.

CHAP. XI.

Probability that without ſome Degree of Phlogiſton no Plant will vegetate.

TO the obſervations in the foregoing chapter, which tend to prove that vegetation is more or leſs vigorous in proportion

portion to the impregnated ſtate of the atmoſphere, with either electric matter or phlogiſton, it may be alleged, that heat without phlogiſton will produce the vegetables of the torrid zone in theſe northern climates, and that phlogiſton is therefore not a neceſſary ingredient in the compoſition of plants.

To make this experiment with accuracy, nothing but the pureſt dephlogiſticated air ſhould be uſed. Air in this ſtate hath been found by Dr. Prieſtley five times leſs impregnated than atmoſpherical air in this climate. The fact is ſufficiently proved by its having ſupported flame and animal life five times longer than an equal quantity of common air.

This experiment ſhews the phlogiſticated ſtate of atmoſpherical air; and if to its large proportion we add the cauſes of ſtill higher impregnation,

impregnation, which muſt exiſt in every hot-houſe where foreign plants are raiſed, it is difficult to imagine that theſe plants are without a great ſupply of this ingredient, ariſing from the quick progreſs of putrefaction: experiment confirms this opinion, which the following extract from Dr. Ingenhouſz ſhews.

Page 49.—" The gardeners, by opening " a hot-houſe early in the morning, which " has been ſhut cloſe during the night, or " at any time in the day, if the ſun has " not ſhined a good deal on it, are very " well aware of a particular oppreſſion they " feel by entering it. I remember to have " felt it more than once, without even ſuſ- " pecting the cauſe of it. Dr. Prieſtley ob- " ſerved this remarkable offenſiveneſs of " the hot-houſes with a more philoſophical " attention; he tried the air within them, " and found it worſe than common air."

The artificial climate of the hot-houſe reſembles that of the tropical latitudes; for heat is the firſt moving principle in warm countries, as well as in the confined air of ſuch houſes.

It is probable, that on a comparative trial of the air of a hot-houſe with dephlogiſticated air, the difference might be found as one to ſeven, or perhaps more, inſtead of one to five, like common atmoſpherical air. The following experiment, made by Dr. Prieſtley, tends to ſhew that plants will not grow long in dephlogiſticated air.

Vol. III. p. 336.—"On the 10th of September, 1776, I took two ſprigs of mint, "and having put each of them into a phial "of rain-water, introduced one of them "into a jar of dephlogiſticated air, leaving "the other in a jar of the ſame ſize, and "with all other circumſtances ſimilar to it

"in

" in common air. For ſome time I could " perceive no difference between them, " and neglected to take notice of them till " the 10th of October following, when I " found the plant in the dephlogiſticated " air quite dead and black, and the other " partially ſo, but the uppermoſt leaves " were ſtill alive. The dephlogiſticated air " was diminiſhed one-ſeventh in its bulk, " and the other half as much."

The water and ſprig of mint, under both jars, in this experiment, were in the ſame circumſtances, yet it is evident that the one expoſed to the dephlogiſticated air died long before the other, but how long was not aſcertained. It is probable, had the water been as totally deprived of its phlogiſton as the air, this plant would have died ſtill ſooner; and there ſeems much reaſon to ſuppoſe, that phlogiſton is ſo general an ingredient in the food of plants, that

that none will grow without ſome degree of it in a diſengaged and active ſtate, though thoſe which have been nouriſhed by a due proportion, and conſequently have a quantity in their compoſition, may for a time ſupport life in the moſt pure dephlogiſticated air.

CHAP. XII.

The Operation of Manure in promoting Vegetation.

VEGETABLE and animal matters will not contribute to the growth of plants, unleſs they have become putrid: when this is the caſe, their component parts are diſengaged by the putrefactive proceſs, in which ſtate they yield the phlogiſtic principle, and are more or leſs good manures in proportion to the quantity of this principle they contain; therefore animal

ſubſtances which poſſeſs it in greater abundance than vegetables, are better manures. All alkaline and abſorbent earths are generally conſidered as manures; but their action in promoting the growth of plants is very different from putrid vegetable and animal ſubſtances, which contain in their compoſition the neceſſary principles for the reproduction of plants.

That this different action may be underſtood, we ſhall premiſe a few particulars relative to the properties of alkaline and abſorbent earths, and fixed air, and then proceed to their different modes of action on vegetable and animal bodies.

Every alkaline or abſorbent earth hath an attraction for acid in proportion to its ſtrength; when theſe earths are perfectly uncombined they are cauſtic, but when ſaturated with fixed air they become quite mild.

mild*. This fluid, called fixed air, is ſtrongly attracted by all abſorbents, and hath been demonſtrated by Mr. Bewley, and Dr. Prieſtley, to be an acid of particular qualities, entirely different from all others †: and as an acid only, we ſuppoſe it attracted by abſorbents; and when combined with them, the compound may be conſidered as a kind of neutral: but its attraction for theſe bodies is weaker than any of the other acids, it is therefore eaſily decompoſed by them all.

Dr. Prieſtley hath ſhewn, that vegetable ſubſtances contain a large proportion of nitrous air ‡, which is a modification of the nitrous acid; and he hath alſo proved, that animal ſubſtances (the fats excepted)

* See Dr. Black on Quick-lime, &c. Edinburgh Phyſical and Literary Eſſays, vol. ii.

† See Dr. Prieſtley, vol. i. p. 31.—and Mr. Bewley in Dr. Prieſtley's 2d vol. p. 337, 338.

‡ Prieſtley on Air produced from vegetable Subſtances, vol. ii.

contain none of this nitrous air, but a portion of fixed and inflammable. The acid in the compoſition of vegetables is a moſt powerful antiſeptic *, and muſt be expelled before they can become putrid, which acid, in the ordinary courſe of natural decompoſition, is diſengaged by the vegetable fermentations previous to the ſtate of putrefaction.

The effect, therefore, of an addition of alkaline ſubſtance, or abſorbent earth, to a maſs of vegetable matter, is that of uniting with this nitrous air, which counteracts the putreſcent tendency of the vegetable ſubſtance; and when the acid is thus drawn from them by theſe abſorbents, the putrefactive proceſs takes place immediately.

If theſe earths are in a cauſtic ſtate when applied to vegetable and animal matters,

* Prieſtley on nitrous Air, vol. i. p. 123.—For further proofs of this acid, ſee chap. 8. part 2.

they

they bring on putrefaction with great rapidity, as their attraction for acid is then moſt ſtrong. But even when they are rendered mild by ſaturation with fixed air, they induce the putrefaction of vegetable matter, by abſorbing the nitrous air in their compoſition, for which they have a much ſtronger attraction, than for the fixed air with which they are combined; conſequently the fixed air, which is a weaker acid, will be diſengaged and expelled as faſt as the nitrous air and abſorbent earths are brought into ſuch contact as to act on each other: and for this reaſon it is that pulverized lime-ſtone, without any calcination whatever, hath been found a good manure, though leſs quick than that which is calcined.

From an over quantity of theſe abſorbents laid on ſoil, the ſeptic powers may be ſo increaſed as to rot the very ſeeds and

plants put into the ground. This we have experienced in the Weſt-Indies, by giving too great a proportion of marl to a ſmall piece of land planted with ſugar-cane; and we are informed, that the ſame exceſs hath frequently been committed in this country. The error may be rectified by ploughing a quantity of freſh vegetable matter into the ſoil, and allowing it to remain in that ſtate for ſix or eight months, or longer; when the nitrous and fixed airs yielded by it will ſo ſaturate the abſorbent earth, as to deprive it of its exceeding ſeptic qualities, and conſequently the vegetable matters added will be rotted and converted into an excellent manure.

From this it is evident in what manner the great advantages ariſe from lime, either in a cauſtic or mild ſtate, laid on land well covered with vegetable matter; and hence the great riſque of laying much lime

on fallowed lands, where there are no vegetable ſubſtances for it to act upon, and acquire a certain degree of ſaturation before the ſeed is put into it. But even under theſe circumſtances, a ſmall quantity will forward the growth of the ſeed, by accelerating that degree of putrefaction which takes place before it begins to vegetate.

To ſaturate theſe abſorbent earths fully, when laid on land, is the work of time, and depends on the quantities of matter they meet with, which contain nitrous and fixed air. Their good effects are often viſible to the fourth and fifth years, and even much longer, if the ground has not been frequently turned; but when complete ſaturation hath taken place with the nitrous air of vegetables, no further good effects are diſcoverable, as they are no

longer capable of abſorbing that nitrous air, which counteracts the progreſs of putrefaction in the vegetable matter, and conſequently no longer act as ſeptics.

The decompoſition of fixed air from theſe earths, by nitrous air, renders the mild abſorbents as effectual and uſeful ſeptics for the purpoſes of manure as the cauſtic, though their effects are not ſo rapid and powerful.

If animal ſubſtances are uſed as manure, their putrefaction is ſufficiently quick without the addition of abſorbents; but when theſe are added, they will attract the fixed air in their compoſition, which acts as an antiſeptic while combined with them, and in conſequence of its diſcharge the animal matter becomes putrid with great rapidity.

From the theory of the operation of abſorbent earths on vegetable and animal matters, which we have here laid down, it is evident that their action, as promoters of vegetation, is entirely confined to that of inducing putrefaction, and thereby generating the food of plants, by diſengaging the component parts of bodies, and conſequently the phlogiſton contained in them; which principle we conceive is univerſally a neceſſary ingredient in the compoſition of the vegetable kingdom.

In the earlieſt ſtate of growth we apprehend a portion of this principle is, by a certain degree of putrefaction, diſengaged from the oily and ſaccharine matter contained in all ſeeds, which nature ſeems to have appropriated for the envelopement of this neceſſary principle, until the plant can ſend forth roots and branches to take it from the earth and atmoſphere.

CHAP.

CHAP. XIII.

Soil improved by Expoſure.

THIS method of improving ſoil ſhews the impregnated ſtate of the atmoſphere: Mr. Tull, in his Eſſay on Huſbandry, recommends a ſufficient degree of pulverization as an equivalent to manure added in the ordinary way, though he ſeems ſenſible that the effect reſults not from pulverization alone.

It is evident that the improvement of ſoil ariſes principally from the influence of the ſun and atmoſphere, and that pulverization increaſes fertility by increaſing the ſurface, to which the principles contained in the air may attach themſelves, though no doubt the texture of the ſoil is rendered

better

better for vegetation by being pulverized. This mode of fertilizing ſoil may be conſidered as a ſlow means of getting from the atmoſphere the ſame principles which are expeditiouſly given by manure in the ordinary way.

Wherever the atmoſphere is moſt impregnated, there the ſoil will be meliorated in the ſhorteſt time, if equally pulverized by turning up. This fact is well known to thoſe who have attended to the agriculture of the warm climates.

CHAP.

CHAP. XIV.

Some Obſervations relative to the Moon's Attraction.

WHAT is hereafter mentioned, relative to the moon's influence on the vegetable kingdom, we offer as theory: all the facts we ſhall adduce in ſupport of this theory, except that relative to the changes of the atmoſphere, we know by information only; but this information we have received through a variety of channels, both Engliſh and French, and all of them agree in the particulars we ſhall take notice of in chap. xxii. of this part.

It is proper to obſerve, that the following theory of lunar action does not interfere with vegetable circulation, as that will be ſhewn to depend on perſpiration, the natural degree of which is determined by climate

climate alone; therefore ſhould the moon's attractive power be ſuppoſed out of the queſtion, we muſt allow that this only evacuation of vegetables is produced by the ſun's heat, independent of the moon: but as the action of theſe two bodies, in all places, bears a certain general proportion to each other, and as the attraction of the one, and heat of the other, ſeem ſo well fitted to unite in producing the ſame effects, *viz.* the perſpiration of plants, we think the analogy of nature may lead to ſuppoſe them much connected with each other in this operation. This appears in a ſtill ſtronger point of view, when the manner of their different actions can be ſo traced as to ſhew how they may unite to produce the ſame effects.

That our ideas of the lunar action may be more clearly underſtood, we ſhall firſt take

take a ſhort view of her influence in promoting the tides, which will facilitate this part of our ſubject.

CHAP. XV.

Of the Tides.

ALL the planets move round the ſun in elliptical orbits, and their ſatellites in orbits ſimilarly elliptical, though not ſo regular as thoſe of the primaries. The ſun's action in ſome places coincides with, and in others counteracts, the influence of the moon, by which counteraction the varieties of tides are principally produced. The higheſt, or ſpring-tides, are at the new and full moon; the loweſt, or neap-tides, are when the moon is in her quarters, or acts in a lateral direction to the line of the ſun's direction. When the moon is new, ſhe is between the ſun and earth, by which poſition her attraction co-operates with

with that of the ſun in almoſt a ſtrait line, and her apparent influence is greater than her real by the amount of the ſun's attraction, which is, upon a calculation of mean force, nearly in the proportion of 1 to $4\frac{1}{4}$. When ſhe is full, our earth is between her and the ſun; and from the ſmall variation between the plane of her orbit and that of the ecliptic (which is only five degrees), we may conſider her as acting in nearly a ſtrait line with the ſun and earth, both at change and full. The diſtance of the moon from the earth, when in the neareſt extremity of her orbit, is to that when in her greateſt extremity as 69 to 70; therefore the ſpring-tides at new and full moon are of unequal heights, as the one muſt happen when ſhe is as 69, and the other when ſhe is as 70.

It is eaſy to comprehend how the united forces of the ſun and moon act on that ſide

of

of the earth next to them, when the moon is between the earth and the ſun; but it is more difficult to underſtand how their actions unite to perform a nearly equal effect on the oppoſite ſide of the earth, ſo as to occaſion the flux and reflux twice every twenty-four hours; and alſo when the moon is full, and the earth between her and the ſun, in what manner tides are produced by the lunar action on the oppoſite ſide of the earth from that in which ſhe is: but it is at preſent ſufficient for our purpoſe that the facts are ſo *.

When the moon is in the quarters, ſhe will attract in a direction nearly at right angles to a line paſſing through the ſun and earth's centres; conſequently the force of the

* It ſeems unneceſſary, in giving a general idea of the lunar and ſolar action, to enter particularly into theſe demonſtrations; thoſe who wiſh for more full information may apply to Sir Iſaac Newton's works, and Mr. M'Laurin's account of his philoſophical diſcoveries.

moon's

moon's attraction on the ſurface oppoſite to her will be counteracted by the ſun's attraction, which tends to depreſs and draw the fluids under the moon into the ſtrait line paſſing between the ſun and earth's centres; and in proportion to the ſtrength of his attraction will the elevation by the moon's influence be diminiſhed, which occaſions the neap tides. Their mean height is about ſix feet ſeven inches, although the moon in the ſame ſituation to the earth would of herſelf elevate the waters to about eight feet ſix inches, were not her influence counteracted by the ſun's attraction in the proportion of 1 to $4\frac{1}{4}$. Thus we find the ſun's attraction in the conjunction and oppoſition increaſing the moon's apparent attraction by an elevation of near two feet, which makes the height of the ſpring-tides, from their joint force in the full and change, equal to a mean height of $10\frac{1}{2}$ feet, while in the quarters we find his attraction

diminiſhing the real influence, which, inſtead of being added to the moon's attraction, is deducted from it, and reduces it in this ſituation to ſix feet ſeven inches.

From theſe things being thus generally underſtood, we may not only comprehend the cauſes of the tides, but eaſily ſee that their variations muſt be conſiderable between the extremes of ſpring and neap, and that thoſe variations chiefly depend on the angle, a line drawn through the earth and moon's centres makes with another line drawn through the centres of the earth and ſun.

CHAP.

CHAP. XVI.

Why the Tides are not in general ſo apparent between the Tropics as beyond them, towards the Poles.

ON conſidering the foregoing chapter it will occur, that the influence of the moon, in elevating the waters, ſhould be generally greateſt between the tropics: that it is the greateſt there, ſeems undoubted, and it would alſo be the moſt apparent, were there different continents in that part of the Atlantic ocean ſituated at moderate diſtances from each other, as the depreſſion on one ſhore is the cauſe of elevation on the other; but in a vaſt ocean, with a few very ſmall iſlands, the reſiſtances to the flux and reflux of the waters are ſo ſmall, that the re-action from them produces no accumulation, and the paſſages between

them are ſo very wide and numerous, that by the time a body of water is put in motion in one direction, it is re-acted on in a contrary, or lateral one, by the waters of the former tide, before it reaches any ſhore ſufficiently extenſive, on which its elevation can be obſerved. This is probably the cauſe of thoſe vaſt currents to be met with in all ſeas, of different velocities at different times, in the ſame or different places, either gliding ſmoothly, or meeting in oppoſite directions, which often occaſion a rough and turbulent ſurface, without wind. Their periods cannot be determined, as their directions in different places muſt continually vary from winds, and different bodies of water, which are daily changing place, and following the influence of the lunar and ſolar meridian. At the iſlands of St. Kitt's, Statia, and St. Martin's, ſituated about the 17th degree north latitude, the tides are hardly viſible, in conſequence of their being

ing ſmall, and at great diſtances from the continent. At Grenada, about the 11th degree, they are more conſiderable, from its being ſituated nearer to the Spaniſh main there ſpring-tides often riſe $2\frac{1}{2}$, and three feet perpendicular.

About Trinidad the difference is greater, and in the channel between that iſland and the main land, called by the Spaniards the Dragon's Mouth, the tides riſe frequently ſix or ſeven feet, or more.

The common tides riſe ſo high on the continent of Surinam, and Iſaac-cape, &c. about the 5th degree north, as to fill the canals which keep their ſugar-mills at work the time of low water.

At the iſland of Bouton, ſituated in 5 degrees 40 m. ſouth latitude, the tides riſe fifteen feet perpendicular*; we may alſo

* See the obſervations of Captain Woodes Rogers, in his Voyages round the World.

conclude, that at Sumatra, Borneo, and other places near the ſame latitudes, they riſe and fall equally, under equal circumſtances of the poſition of land.

CHAP. XVII.

The foregoing Chapters applied to Air.

HAVING ſeen the moon's influence by her attraction on the waters upon the ſurface of the earth, it follows, that all bodies will be acted upon by the ſame cauſe, as matter, under all forms whatever, is ſubject to gravitation. Air, one of the moſt moveable and light fluids we know, is ſubject to theſe laws, and will be elevated in proportion to its gravity.

Water is capable of being raiſed $10\frac{1}{2}$ feet perpendicular by the ſun and moon's combined attraction; and if we ſuppoſe our

atmoſphere equal to the weight of 16 miles perpendicular, of air equally denſe as at the ſurface throughout the whole, or of any other height, the ſame attraction which is capable of ſupporting a column of water $10\frac{1}{2}$ feet high will ſuſpend a column of air of the denſity and height above-mentioned nearly to five miles, and $\frac{1}{3}$ of a mile, or a column of any other fluid to a perpendicular height nearly equal to one-third of that which the whole preſſure of the atmoſphere can raiſe them to.

From the above elevation of the air it ſeems natural to ſuppoſe, that the mercury in the barometer ſhould ſink every new and full moon, in proportion to the diminiſhed weight of the atmoſphere; but this is not found to be the caſe: and although the perpendicular height of the barometer does not diſcover theſe changes in the weight of the atmoſphere, yet it ſhould

manifeſt itſelf in the heat of boiling water, and the efferveſcence of fermenting fluids, if the changes are conſiderable. It is well known that water boils with leſs or more degrees of heat, in proportion as the preſſure on its ſurface is diminiſhed or increaſed; and that the efferveſcence of fermenting fluids is increaſed or diminiſhed by the ſame cauſe, is alſo well underſtood.

We made ſeveral attempts to aſcertain this fact with boiling water, but the difference was not diſcoverable. We had next recourſe to fermenting fluids, as a more delicate teſt, and after a regular attention for ſeveral months, to the ſurfaces of at leaſt thirty vatts, which were conſtantly filled with fermenting liquors, kept in the ſame degree of heat, and mixed in the ſame proportions for the diſtillation of rum in one of the Sugar-iſlands, we thought that a more briſk efferveſcence at new and full moon,

moon, than at other periods, was diſcoverable. The ſame remark we have ſince heard made by others; yet the difference was ſo little, that it is ſtill a doubt with us if it could any thing reduce the boiling point of water.

CHAP. XVIII.

How the perpendicular Preſſure of the Atmoſphere is kept up, notwithſtanding the tendency of the Moon's Attraction to diminiſh it.

AIR is a compreſſible fluid, and occupies more or leſs ſpace according to the reſiſtance it meets with: the effect of the moon's attraction is to diminiſh the weight of the atmoſphere, by elevating the column of air immediately under her meridian. In this way the air is ſlowly rarified from top to bottom, in proportion as the

the moon's influence increaſes, not only towards the full and change, but alſo towards the lunar meridian of each twenty-four hours.

It is well known, that bodies on the ſurface of the earth, as well as the earth itſelf, retain much air in their cavities and pores, and even contain it intimately blended in their compoſition, which they part with in greater or leſs quantities, according to the preſſure on their ſurfaces; therefore when the atmoſphere is moſt ponderous, its weight will drive the moſt denſe air, which is conſtantly neareſt the ſurface, into thoſe cavities and pores of all bodies with which it comes in contact; and as the preſſure diminiſhes by the moon's attraction increaſing, as ſhe approaches to her meridian, that air which was ſeemingly fixed begins to expand itſelf, and follows the riſing column, until the increaſed perpendicular

dicular height of the column adds a weight equal to the moon's increaſed attraction, or ſuſpending power; by which means the atmoſphere will at all times be nearly of the ſame denſity and weight at the ſurface of the earth, as the increaſed height of the atmoſphere, when the moon's action is greateſt, will be exactly equivalent to that attraction. When ſhe declines from her meridian, and her attraction begins to diminiſh, it will operate in the ſame manner as an additional weight given to the atmoſpere; and thoſe particles which had expanded themſelves, or others, in their ſtead, will be forced back into their former lodgments; by which the weight of the atmoſphere, or preſſure on the ſurface of the earth, will at no time vary ſo much as at firſt view might be expected.

Beſides this expanſion of the air upwards, a lateral one will alſo take place, as

as the air, removed to a diſtance from the lunar meridian influence, will preſs in to reſtore the equilibrium. This conſequence is ſo very evident, that ſeamen look for an increaſe of wind * when the moon riſes to her meridian, particularly if it is calm, or nearly ſo.

CHAP. XIX.

The Effect which we ſuppoſe the above Motion of the Air has on the Growth of Vegetables.

PLANTS, by their branches and foliage, expoſe a very large ſurface to the contact and influence of the air, all of which are capable of diſcharging perſpiration in proportion to the warmth of their ſituations.

* Dr. Mead makes this obſervation.

On the quantity of perſpiration diſcharged by plants depends the quantity of moiſture they are capable of imbibing. This fact is proved by Dr. Hales in his Vegetable Statics; it is therefore to be obſerved, that the diſcharge of perſpiration, is the cauſe of abſorption and circulation, which take place but in proportion to it.

The ſun and moon, by occaſioning the perſpiration of plants, do actually promote their internal circulation, as the vacuities produced by this diſcharge muſt be ſupplied by the ſucceeding fluids; conſequently while perſpiration continues, circulation and abſorption muſt be the effect, and thus the ſun and moon act as firſt cauſes in the growth of the vegetable kingdom.

Dr. Hales demonſtrated by various experiments, that plants imbibe large quantities of air, and that that ſubtile fluid retains

tains its elaſticity in paſſing through all their parts, and may be diſcharged from the hardeſt woods, by only taking a part of the preſſure of the atmoſphere from off their ſurfaces.

From theſe facts, and the effects of ſolar heat and lunar attraction, we ſhall offer the following theory of vegetable circulation.

We have already obſerved, that the difference between the plane of the ſun and that of the moon is about five degrees; from which ſmall difference they may, generally ſpeaking, be conſidered as making their progreſs on the earth within nearly the ſame limits, and that their influence will conſequently bear in all ſituations nearly the ſame general proportions to each other; or in other words, that theſe places which are warmeſt will have the greateſt

lunar

lunar influence, and thoſe more removed from the limits of the ſun's progreſs will alſo ſuffer a diminution of the moon's power.

Between the tropics, the influence of both ſun and moon are greateſt; and as the moon advances from her quarter towards the full, ſhe daily continues to act ſtronger, by gradually elevating the column of air under her meridian higher and higher, until ſhe arrives at the full, when her meridian influence is the greateſt.

This elevation of the air lets looſe that which was ſeemingly fixed in bodies, as each particle will expand itſelf in proportion to the diminiſhed preſſure; and thoſe contained in vegetables which retain their elaſticity will, from their dilatation, force a diſcharge of perſpiration even to the extremities of the higheſt trees; in

conſequence

conſequence of which abſorption muſt be proportionally increaſed, and air, water, phlogiſton, or whatever food the earth furniſhes proper for vegetation, will be abſorbed and carried through the courſe of circulation. Theſe effects naturally follow from ſuch alterations in the perpendicular height of the atmoſphere as we have pointed out. According then to this theory, plants diſcharge more copiouſly their perſpiration by the air in their compoſition being expanded twice every twenty-four hours, and the diſcharges are diminiſhed an equal number of times within the ſame ſpace, by the external air returning to its former perpendicular height. Theſe diſcharges, although in equal and regular times, may occaſion a variety in the vigour and circulation of vegetables, independent of what reſults from the expanſion and contraction of the air and fluids in their compoſition by heat and cold.

We

We may further ſuſpect, that the degree of moon-light by which they are influenced may alſo make their circulation at different times more or leſs vigorous: it is to be wiſhed, that it were tried what effect the rays of the moon have on the growth of the vegetable kingdom.

CHAP. XX.

Vegetation proportioned to theſe Cauſes in different Climates.

THE near coincidence of the lunar and ſolar planes makes it more than probable, that the action of theſe bodies hath been intended to aſſiſt each other.

The lunar power ſeems to co-operate with the ſun's dilating and relaxing heat, to promote the perſpiration of plants, by aſſiſting the expanſion of the air in their

 compoſition,

compoſition, with removal of external preſſure, while the ſun's warmth keeps their fluids in an attenuated and perſpirable ſtate. Thus we ſuppoſe, by the joint action of the ſun and moon, the neceſſary perſpiration in different climates * ; for the growth of ſuch plants as are natives of them, is accompliſhed, and becomes greateſt where the greateſt quantity of matter is generated by the ſun's heat for their production.

Between the tropics, where theſe luminaries act with full force, vegetation is quickeſt: as we recede either to the north or ſouth, beyond theſe lines, the rapidity of putrefaction, and the progreſs of vegetation, regularly decreaſe in proportion as the diſtance from them is increaſed; and thus by comparing the ſtate of vegetation

* From the experiments of Dr. Hales, the ſame plant varies in its diſcharges, without its health being hurt.

in

in different countries with the degree of ſolar and lunar influence in them, we ſhall find our theory correſponding with the ſtate of facts.

CHAP. XXI.

Of the Moon's Influence on Vegetables counteracted by Cold.

THE northern climates have as much of the moon's influence in winter as in ſummer, yet vegetation ſtops when the ſun's heat is diminiſhed to a certain degree.

By the theory of vegetable circulation propoſed, the moon is conſidered as capable of influencing the growth of plants principally by the changes which ſhe induces in the ſtate of the atmoſphere, but the effect of theſe changes muſt depend on the condition of plants at the time they are acted upon.

Perſpiration we have already conſidered as the primary cauſe of circulation and abſorption; but this primary cauſe cannot exiſt, except under certain circumſtances of heat and fluidity. The abſence of the ſun's influence to a certain degree will therefore totally prevent this diſcharge, and conſequently bring on an entire ſtoppage of motion; and the fluids thus ſtagnated will by the cold become denſe and adheſive, while the rigidity of the ſolid parts will alſo be increaſed. Both of theſe cauſes muſt powerfully counteract the expanſion of the air in their compoſition, and abſolutely prevent its enlargement of volume by ſo ſmall a cauſe as the alteration of preſſure, unaſſiſted by a due degree of heat.

When the ſun returns to our hemiſphere, his influence, by the combined action of heat and light, ſoon removes the obſtructions above mentioned, and the perſpiration

tion and growth of plants proceed in conſequence with a rapidity proportioned to theſe cauſes, which are greatly inferior to the action of the ſame cauſes in the tropical climates, except for a ſhort ſpace in the middle of ſummer, when the ſun is in the northern tropic, at which time we have in this climate more of his light than countries ſituated near the equator.

If a tree is cut down in winter, and left in the air, it will vegetate as early in the ſpring as other trees of the ſame kind; and this will continue to go on while the air and fluids in its compoſition are capable of expanſion from the degree of heat then influencing them; but as its diſcharges are not ſupplied by the abſorption of freſh matter, the tree is ſoon exhauſted, and dies.

If a branch is cut from a tree in winter, and gradually introduced into a warmth

not greater than that of ſummer, it will vegetate by that external application of heat; and if the plant from which it was cut be properly lifted, and placed in the ſame temperature, and ſupplied with water, it will alſo vegetate, and continue to do ſo.

Theſe facts ſtrongly prove that perſpiration is the cauſe of circulation and abſorption in plants, and that theſe cauſes, which produce this diſcharge, act as primary or enlivening principles of the vegetable kingdom; conſequently growth can only take place in proportion to the degree of their influence. The action of the leaves of plants, in dephlogiſticating impregnated air, has ſomething the appearance of a vital principle; but this power is not inherent in the plant, but is the effect of the action of light on plants.

Theſe

Theſe conſiderations ſeem ſufficiently to point out why lunar influence can have no effect without a certain degree of heat; and that the moon's action in ſummer is leſs remarkable here than in the torrid zone, evidently reſults from the poſition of her orbit, by which her greateſt action, like that of the ſun, is nearly confined to the tropical climates.

CHAP. XXII.

Facts in proof of the foregoing Theory.

IN the tropical latitudes there is generally a fall of more or leſs rain at each change and full moon, unleſs the weather be exceedingly dry; and even then it ſeldom paſſes without a clouded ſky, and evident changes in the ſtate of the atmoſphere.

In theſe climates, if timber of the hardeſt kind is cut at either new or full moon, it

is found more full of moiſture, or ſap, than at other times, which ſoon decays the wood by running (we ſuppoſe) into a kind of fermentation; whereas if the ſame kind of timber is cut when the moon is in her quarters, it will be found more ſolid, and of greater duration. This is generally conſidered in the torrid zone as a fact, by thoſe who cut and prepare hard wood for ſale, and from many of them we have this information.

The manufacturers of caſtor oil in ſome of the Sugar Iſlands gather the nuts at change and full moon, and generally find them yield from a fifth to a fourth more at theſe times, than when the moon is in her quarters. This information we alſo have from the manufacturers themſelves.

In tranſplanting trees in theſe climates, if it is done at the quarters, they ſeldom ſucceed,

ſucceed, or at leaſt they continue languid and feeble for a long time; but if done at either the change or full exactly, they generally thrive well; and this we ſuppoſe to ariſe from the following cauſes:

Before the change and full the dilatations are daily growing greater, by which a too copious diſcharge is made before the plant can draw from the earth any ſupply; whereas after the change or full the dilatations are daily diminiſhing, and the plant is not by over-perſpiration exhauſted of the large ſhare of juices with which it was filled by its greateſt dilatations, before taken from its former place of growth.

In theſe countries it is alſo aſſerted (particularly among the French, who are generally more attentive to theſe *minutiæ* than the Engliſh), that the period of the moon ſhould regulate the planting of moſt ſeeds, and

and gathering of herbs for medical purpoſes. That theſe periods are by them attended to, in planting and gathering, is an undoubted fact, and the generality of the practice is a ſtrong preſumption in favour of its juſtneſs.

If we conſider that aſtoniſhing power which plants poſſeſs when influenced by light, we are naturally led to view theſe aſſertions with a greater degree of faith; for it is impoſſible to ſay *a priori*, what effect light and darkneſs may have in diminiſhing or increaſing the qualities of plants.

CHAP.

CHAP. XXIII.

Reaſons why Vegetables are leſs capable of ſupporting Changes of Climate than Animals.

VEGETABLE circulation, or life, hath already been ſhewn to depend on the action of external cauſes, by which the diſcharge of perſpiration becomes the immediate promoter of circulation. This is the only natural mode of evacuation of the vegetable kingdom; therefore when it is diminiſhed by cold, or augmented beyond its due degree by an exceſs of heat, plants are flung into bad health, and nothing can reſtore them to full vigour but the increaſe or diminution of this diſcharge to its proper quantity. For this reaſon it is, that vegetables can thrive in ſuch climates only as furniſh a due proportion of food, and occaſion

occaſion that degree of perſpiration which is exactly fitted to their particular organization.

From the ſimplicity and confined ſtate of vegetable evacuation, there is great reaſon to ſuppoſe their food of a uniform and homogeneous nature; were it otherwiſe, it is difficult to imagine that all its ſuperfluous parts could with equal facility be diſcharged by perſpiration. Water, therefore, impregnated with ſome principle neceſſary to vegetable life, ſeems to enter the compoſition of plants as a vehicle only, which, like phlogiſticated air, is in the courſe of its circulation deprived by the plant of the matter with which it is impregnated; and when this is accompliſhed, the aqueous parts charged with the worn off matter, which reſults from the friction of the circulating fluids, is like the dephlogiſticated air diſcharged as an excretion.

This

This is confirmed by an experiment of Dr. Hales's; he collected the perſpiration of many plants, ſuch as fig, apple, cherry, apricot, and peach trees, rue, horſe-radiſh, and parſnip, &c. all of which were very clear, and without any apparent difference, though from plants of ſuch different qualities. It nevertheleſs became ſooner putrid than common water, which is a proof of its containing ſome heterogeneous matter*.

Vegetables can take into their compoſition, matters diſſolved in the water they imbibe, which may be productive of their death. When ſuch matter is abſorbed as can neither be aſſimilated nor diſcharged by perſpiration, circulation is obſtructed, and either the whole plant, or thoſe particular parts in which ſuch obſtruction is ſituated,

* See Vegetable Statics, vol. i. p. 49.

muſt

muſt languiſh and die. Theſe reaſons ſeem ſufficiently to point out why plants adapted to particular places, are incapable of accommodating themſelves to ſituations where they are differently influenced.

Animals have a variety of evacuations, and are therefore leſs affected by change of climate. If perſpiration is diminiſhed by cold, the urinary and pulmonary diſcharges are augmented; and when this evacuation is increaſed by warmth, theſe diſcharges are diminiſhed. In this manner the bodies of ſuch animals as are capable of theſe evacuations are accommodated to different climates; by which, together with the inteſtinal outlet, the moſt heterogeneous matter taken in as food, is emitted after its nutriment is extracted.

From the complicated conſtruction of animal bodies, we are at firſt view led to ſup-

poſe them more ſubject to derangement than they would be, were they more ſimply fabricated; but this does not ſeem to be the caſe. That very complication is the ſource of their great powers in extracting their nutriment from the moſt heterogeneous food, and diſcharging their fæces by various outlets, fitted to their different qualities, and the variety of climates to which they may be expoſed.

CHAP. XXIV.

CONCLUSION.

FROM what hath been ſaid in the foregoing Chapters, it is apprehended that the following particulars are rendered highly probable:

In the firſt place, that a certain degree of phlogiſton is neceſſary to vegetation, and

and that the quantity diſengaged in any given diſtrict of the globe is exactly in proportion to the degree of ſolar and lunar influence in that diſtrict.

Secondly, that the action of manure in promoting vegetation bears a certain proportion to the quantity of phlogiſtic matter contained in thoſe manures; and that foſſil ſeptics act by promoting the putrefaction of vegetable and animal bodies, which ſeparates the component parts, and by that means only act as manures.

Thirdly, that the growth of plants is affected by climate, in proportion to the degree of light and perſpiration which reſults from the ſun and moon's joint influence.

PART

PART II.

Of Aliments, their Digeſtion, and Effects on Animal Bodies, relative to Climate.

CHAP. I.

The Object of this Second Part.

ON the productions of the vegetable kingdom depend thoſe of the animal; as the latter cannot exiſt beyond a due proportion to the general ſtate of the former; and as the body of every animal firſt exiſted in a vegetable form, from which it hath been changed by the proceſs of animalization once or oftener, it ſeems naturally to follow, that the ſtate of animal

bodies muſt be influenced by the qualities of their nouriſhment; and as the qualities of that nouriſhment depend on climate, the condition of the animal muſt not only be affected by the ſame cauſe through its food, but alſo by the immediate action of thoſe cauſes, which ſo much influence the health and growth of vegetables.

The object therefore of the ſucceeding Chapters, is an attempt to examine into the changes induced on the human body by food and climate, and to point out ſome of their varieties, and the cauſes which produce them.

CHAP. II.

Diviſion of Aliments.

BEFORE we begin this examination, it ſeems proper to make ſuch a diviſion of food, as will aſſiſt in explaining

ing what is meant by different aliments.

Vegetables as food, we ſhall conſider under two heads or claſſes, and theſe claſſes we ſhall diſtinguiſh by their general properties. In the firſt, we include all vegetables which are capable of the vinous and acetous fermentations, or of the acetous only, without the vinous. In the ſecond, we ſhall comprehend ſuch vegetables as emit an alcaline vapour firſt, and then run more or leſs into an acid ſtate, before putrefaction takes place, or into putrefaction, without any previous diſcoverable degree of aceſcency.

We ſhall next divide animal ſubſtance into three claſſes, by the names of, Half Animal Food, Simple Animal Food, and Compound Animal Food. By the firſt is meant, that which is between vegetable and animal, yet partakes of the nature of both,

 without

without being either; ſuch is the milk of herbaceous animals.

By the ſecond, is meant the fleſh of thoſe animals which feed on vegetables; ſuch as cattle, ſheep, &c.

The third comprehends thoſe which are carnivorous, whether biped, quadruped, fiſh, fowl, or reptile.

CHAP. III.

Experiments relative to the Diviſion of vegetable Aliments.

BY our diviſion of vegetable aliments, the ſecond claſs comprehends thoſe plants generally ſtiled alcaleſcent and aromatic; yet the following experiments lead us to ſuſpect, that many of theſe yield an acid, after the diſcharge of their moſt volatile part by coction, or long ſtanding;

and that perhaps very few, if any, are totally void of ſome ſmall degree of aceſcency; but we apprehend that in moſt of them the aceſcent qualities are ſo trifling, and the alcaleſcent ſo very ſtrong, that the former can have little or no effect in animal bodies, when thoſe plants are uſed as food.

A turnip deprived of its ſkin, was well boiled, and then broke down in a tea-cup, with cold water ſufficient to reduce it to a thickneſs like that of rich cream.

Another turnip alſo deprived of its ſkin, and raw, was cut in thin ſlices, and put in a ſecond tea-cup, to which a quantity of water was added ſufficient to cover it.

The ſkins of theſe turnips were well waſhed, then cut in ſmall pieces, and put raw in a third tea-cup, with water enough to cover them.

In a fourth cup, was put the ſkins of two turnips which were well boiled, and cold water added ſufficient to cover them.

In three days the boiled turnip in the firſt cup began to emit an agreeable ſmell, and for ſeveral days the water ſqueezed from it gave a red tinge to the ſyrup of violets; after this, the acidity began to diminiſh, and in four days more it emitted a putrid ſmell. About the ſixth day, the raw turnip emitted a vinous ſmell, and on the ſeventh the water from it alſo turned the ſyrup of violets to a light red; but previous to theſe appearances, a ſlight ſmell like that of the ſkins was emitted, which ſhewed, that even the turnip itſelf contained a very ſmall degree of alcaline matter.

The raw ſkins ſmelt for ſeveral days as if freſh, and the ſame ſmell increaſed and went on, without any appearance of acid;

about the tenth day there was a kind of diminution of this ſmell, but no perceivable acidity, the putrid ſmell returned, and the ſkins were diſſolved into a mucilage of moſt diſagreeable odour.

The boiled ſkins reſiſted all change till about the ſeventh day; they then began to emit a kind of acid ſmell, which was ſo exceedingly weak, as to be diſcoverable by the odour only, and not without particular attention; from this ſtate they changed to the putrid, without ſtronger proof of acid.

An onion was cut in thin ſlices, then chopped very fine, and mixed in a wine-glaſs, with a ſufficient quantity of pure water to make it into a pulpy conſiſtence. No change to acidity was perceivable in this mixture, probably from the ſtrong odour which it continued to emit until diſſolved by putrefaction.

Another onion was well boiled, and mixed in a ſecond wine-glaſs with an addition of cold water, with which it was alſo ſtirred into a pulp. This emitted no ſmell, as its volatile part had been diſſipated by the heat. About the fifth day it began to yield a kind of vinous ſmell, which became more and more perceivably acid for near ſix days; it then gradually diſappeared, and putrefaction came on.

A quantity of common muſtard in powder was mixed with water, and put in a wine-glaſs; an equal quantity of the ſame muſtard, mixed with a greater proportion of water, was boiled until the loſs by evaporation reduced it to the conſiſtence of the cold mixture. The raw muſtard emitted a very volatile pungent odour for near four weeks; the boiled muſtard had loſt its pungency, and continued without ſmell to the ninth day, about which time a very faint acidity was diſcoverable by ſtrict attention

to

to the ſmell; after which it became putrid, and went on to the laſt ſtages without diſcovering any further acid. The raw muſtard arrived at perfect putrefaction without any palpable degree of acidity.

Theſe experiments were made in the month of June, when the weather was remarkably warm.

CHAP. IV.

Of the Fermentations.

AT preſent we muſt conſider the vegetables ſpoken of as belonging to the firſt claſs, which are capable of both the vinous and acetous fermentations, or of the acetous only, without the previous performance of the vinous.

The firſt fermentation is attended with a degree of heat conſiderably above the temperature

perature of the ſurrounding atmoſphere, and this heat increaſes in proportion to the violence of the effervescence, which determines the duration of the proceſs; but this laſt circumſtance is regulated by the denſity of the mixture, and temperature of the place in which the body is ſet to ferment.

When this inteſtine motion is over, and the vinous ſpirit perfectly formed, if the liquor is allowed to remain at reſt, the acid fermentation ſoon begins to diſcover itſelf, particularly if the temperature, in which the vinous or firſt fermentation took place, was ſo great as to hurry it on with too much rapidity. This ſecond fermentation is attended with greater warmth than the former, and that very fluid which by diſtillation would have yielded a vinous ſpirit, now gives an acid, which hath been generated by the ſecond fermentation. In a heat of 90 degrees by Fahrenheit's thermometer,

mometer, the vinous, or firſt fermentation, is ſo quickly run through in the open air by unboiled vegetable juices, as often to paſs unperceived when the liquor is very thin, and poſſeſſed of little tenacity; whereas in a temperature about 60 or 62 degrees the vinous fermentation comes on moderately, and requires a long time for being completed.

After vegetables paſs the ſecond ſtage, or acid fermentation, the putrid and laſt ſucceeds, which is common to both vegetable and animal ſubſtances; and in a heat about 108 or 110 degrees of the ſame thermometer, the acid ſoon yields to putrefaction, which in that temperature comes on with rapidity, but in much leſs degrees of heat, the acid, like the wine, loſes its qualities more ſlowly *.

The

* The putrid fermentation in vegetable ſubſtances hath been ſuppoſed to generate heat; but this does not ſeem to be

The vegetables of the ſecond claſs paſs into putrefaction in the ſame manner with thoſe of the firſt, yet theſe different claſſes conſiſt of ſome different component parts, or of the ſame parts very differently proportioned. As thoſe of the firſt claſs undergo a proceſs to diſcharge a conſiderable quantity of matter before they are advanced towards their diſſolution, as far as thoſe of the ſecond, yet they are ſimilar in the proceſs of putrefaction, and by diſtillation yield the ſame ſalts, not only with each other, but with all animal ſubſtance whatever; may we not therefore conſider thoſe of the firſt claſs after the two firſt fermentations, as more aſſimilated to the nature of animal ſubſtance; and that thoſe of the ſecond by their nature approach more to animal matter, as they are in a very great degree with-

be the caſe; no heat is produced by the putrefaction of animal matter; and vegetable mixtures, when they paſs the acid ſtate, return to the temperature of the atmoſphere.

out

out thoſe qualities which diſtinguiſh the firſt claſs ſo remarkably from animal ſubſtance?

Theſe reflections ſeem to make it a reaſonable inference, that the two firſt fermentations or changes are in ſome way performed in the courſe of the digeſtion and aſſimilation of vegetables of the firſt claſs, and in thoſe of the ſecond alſo, in ſo far as they are capable of theſe fermentations.

We ſhall endeavour to follow this idea, and ſhew that they actually do undergo theſe changes in the courſe of animalization.

CHAP.

CHAP. V.

Of the Changes of vegetable Matter when taken into the Body as Food.

MOISTURE as well as heat is neceſſary to the progreſs of fermentation; but as a ſufficient degree of both for that purpoſe are never wanting in living animal bodies, we need not take up time in aſcertaining how much is neceſſary.

From the rapidity of the firſt fermentation, in a temperature equal to that of animal heat, we may reaſonably conclude that its progreſs in the ſtomach is little attended to, particularly when blended with many other ſubſtances, which is generally the caſe; yet after eating conſiderable quantities of rich ſummer fruits (unmixed with animal matter) which produce the vinous ſpirit in the greateſt abundance, the moſt evident

evident proofs both by the ſmell and taſte of the eructations in the courſe of their digeſtion, diſcover that the vinous fermentation is actually performed in the ſtomach. Aliments of the farinacious and green vegetable kind, do not yield a vinous taſte when vomited up, but one ſomething different, which is rather ſimilar to wort or new beer; this is the real taſte of theſe ſubſtances when fermented out of the body, and is evidently diſcovered after eating plentifully of bread and pot herbs, without any mixture of animal matter; their retention in the ſtomach after brought to this ſtate is attended with acid, into which it is changed by the heat with greater or leſs rapidity, in proportion to the weakneſs or ſtrength of the habit.

The real and frequent exiſtence of this acid in the ſtomach is indubitable; and this fact, together with what we have obſerved above, relative to the eructations in the courſe

courſe of digeſtion, are ſtrong proofs that the firſt fermentation hath actually paſſed in the ſtomach, previous to the formation of this acid, as no art hitherto known can alter the ſucceſſion of the vegetable fermentations, or renew them a ſecond time in the ſame body, when they have once been completed.

The ſtomach and inteſtines do not appear the place intended by nature for perfecting this ſecond ſtage or change to acid, as the production of it there is very generally attended with uneaſineſs; it is therefore from this conſideration preſumable that the chyle hath not undergone the acid fermentation, when abſorbed by the lacteal veſſels; and as animal ſubſtances are capable of the putrid or laſt fermentation only, the middle change or tranſition to acid we ſuppoſe is performed after the abſorption of the chyle, and before its aſſimilation into animal matter.

CHAP.

CHAP. VI.

That the Chyle and Milk of the ſame Animal are the ſame Fluid.

THE chyle and milk of the ſame animal have been by ſome conſidered as very different fluids, while by others a contrary opinion is maintained. The laſt of theſe ſeems moſt probable, and we apprehend the following facts will prove it ſtrongly.

Dr. Young hath in a very ſatisfactory manner proved, that acid abounds in the milk of different animals, in proportion to the quantities of vegetables they eat*; and he

* Altera opinio, ſcilicet, lac ex novo chylo recens in ſanguinem ingreſſo oriri, magis eſt probabilis; nam magis vel minus lac aceſcit, pro natura alimenti: Hoc ſæpe expertus ſum in lacte canis, nunc cruda carne, nunc vegetabilibus ſolis, paſtæ; priore cibo, lac putreſcens, poſteriore ab initio aceſcens, fuit.

he hath alſo ſhewn, that the milk of ſuch animals as are perfectly carnivorous will not run into acid, but become directly putrid *. This evidently follows in conſequence of the acid fermentation having been performed previouſly in the herbaceous animal, which was the food of the carnivorous one; therefore the ſame matter cannot undergo the ſame proceſs a ſecond time. On this principally depends the difference between vegetable and animal ſubſtances, as food, which we ſhall hereafter more fully explain.

To aſcertain the ſtate of the chyle of herbaceous animals, when ready to be mixed with the blood, we cut through the tho-

Lac etiam omnium animalium, quæ ex vegetabilibus nutriuntur, aceſcens eſt.—Dr. Young de Natura et Uſu Lactis in diverſis Animalibus, caput viii. ſect. 1.

* Si ſolis vegetabilibus, lac aceſcens; ſi vero carne nutriatur canis, alcalinum eſt; adeo ut recens lac chartæ ſucco caryophillorum imbutæ viridem colorem ſæpe inducat. —Same book, ſect. vi. de Lacte Canino.

racic

racic duct of a cow, and ſqueezed forward the chyle from the receptaculum chyli. In our firſt and ſecond attempts, the quantities obtained were ſo ſmall, and ſo much mixed with blood, that no experiments were made with them, leſt they ſhould lead to a fallacious concluſion. Our third trial, which was on a cow newly taken from graſs, proved more ſucceſsful, though it ſtill had a proportion of blood: but reflecting that ſhould there be any aceſcency in the chyle, this mixture would rather diminiſh than promote it, we began our experiment. The quantity did not exceed two tea-ſpoons-full, to which were added three more of pure water, to prevent exſiccation. After mixing the chyle and water, which amounted to five tea-ſpoons-full in all, they were put in a ſmall wine-glaſs, and covered lightly with a piece of paper. This mixture ſtood ſeven days without any ſenſible change; on the eighth

it began to emit a kind of vegetable ſmell, which became vinous on the ninth; on the tenth the ſmell was ſomething acid, which became rather more ſo the three ſucceeding days; but the ſmell even to the time of putrefaction, which began on the fourteenth day, was never diſtinctly acetous, but continued mixed with a vinous odour.

Theſe circumſtances may, we apprehend, be accounted for in the following manner:—Animals, like cows, which eat herbage only, and that in great quantities, may have the firſt fermentation of the whole vegetable maſs imperfectly accompliſhed in their ſtomachs and inteſtines; a proportion of the unfermented juices will conſequently be mixed with the reſt, and abſorbed by the lacteal veſſels *.

In

* The account given of a wine made from mare's milk by the Tartars, and ſome other eaſtern nations, may be accounted for from Dr. Young's Experiments, by which it appears, that

In the ſecond place, the blood which was mixed with the chyle would get a putreſcent tendency, and abſorb the acid as ſoon as formed, which acid would have been diſengaged had the chyle been free of all animalized matter. This ſeems confirmed by the great time which elapſed before any degree of putrefaction took place, although the experiment was made in the end of June, and beginning of July, when the weather was very warm; and it may with great reaſon be ſuppoſed, that

that the milk of the non ruminantium is leſs aceſcent than that of ruminating animals. From this circumſtance the milk of the non ruminantium ſeems ſtill capable of a conſiderable degree of the vinous fermentation, which retards its progreſs to acidity; therefore ſomething of a ſpirituous nature may be expected from it. The following quotations from Dr. Young may ſet forth the fact:

Sect. III.—Lac ruminantium, etiamſi multum mucilaginoſæ partis continet, tamen magis eſt aceſcens, quam lac non ruminantium.

Mucilaginoſa pars lactis ruminantium facile ſeparari poteſt, vel ſponte, vel variis coagulis.

In lac vero non ruminantium, hoc vix obtinere poteſt, niſi addantur acida, dum lac coquatur.

the mixture of animal juices in the chyle would have emitted a putrid ſmell in half that time, had not their tendency been counteracted by the acid of the chyle.

This experiment, together with thoſe of Dr. Young, mentioned in the notes, and the aceſcent ſtate of the milk of herbaceous animals, all taken together, amount to very ſtrong proof that the ſecond, or acid change, is performed by the chyle after its mixture with the blood.

CHAP. VII.

Of the Change to Acid in the Chyle.

FROM what hath been ſaid, it is probable that a change to acid in the chyle of herbaceous animals doth actually take place, or the matter contained in ſuch vegetable juices as are capable of producing

an acid could not be diſcharged; and this muſt be the caſe before it can be aſſimilated into animal ſubſtance. How this diſcharge is accompliſhed may, we think, be explained in the following manner:

It is evident, that no degree of effervescence can take place after the mixture of the chyle with the blood; its ſeparation muſt therefore be affected by other means; and theſe means, we ſuppoſe, are abſorption, by trituration with ſome component matter in the body; and that the oily parts are thoſe which do actually abſorb, entangle, and blunt the acid as ſoon as formed, will more evidently appear in the following chapter. The chyle thus loſing its acid, and the watry parts going off by the excretions, the remaining matter is in ſome degree animalized, or rather ſo aſſimilated as to be rendered fit for uniting with, and forming the different parts of animal bo-

dies, as it hath now got quit of its vegetable properties, and in that ſtate is ſimilar to animal ſubſtance, both in its fermentation and product.

The effects of vegetable food on animal bodies clearly follow from ſome qualities peculiar to them as vegetables; theſe qualities ſeem to be the power of generating an acid, which is afterwards found in the body.

If we attend to the nature of animal ſubſtances, which are made up of the nutritious parts of vegetables only, that have undergone the two firſt fermentations, or changes, we are led to conſider the laſt, or putrid in them, as a continuation of the ſame train which would have taken place in the vegetable itſelf; but from being put into circulation, and as it were brought from vegetable into animal life, it hath

been prevented; and when that circulation ſtops, which counteracts its natural tendency, it will run into putrefaction, as the conſequence of having undergone the two firſt fermentations previouſly.

CHAP. VIII.

Of the Acid in Animal Bodies.

IT is a well-known fact, that acids combined with oils give them firmneſs, and even ſolidity. The fat of herbaceous animals is an oil in a concrete form, which by diſtillation yields a phlegm that is highly acid: if this acid is entirely diſſipated, or nearly ſo, by repeated diſtillations, the denſe fats become fluid oils; nor can the ſmalleſt portion of a volatile alcaline ſalt be got from the fat of herbaceous animals, when thoroughly deprived of all fleſhy and membranous parts *.

* See Macquer's Chemiſtry, Analyſis of Animal Fats, and Obſervations thereon.

Hence

Hence it is evident, that although fats are parts of animal bodies, yet they poſſeſs not the ſame properties with the other parts of animal matter. From a deficiency of this acid in the fat of carnivorous animals, their oily parts are more fluid than thoſe of the herbaceous kind; and when a putreſcent tendency in the body is general and ſtrong, the fats become more fluid from a want of this acid: hence thoſe who are far gone in conſumptions and ſcurvies, diſcharge an oil with their urine, which floats on its ſurface in very ſmall globules.

This acid being found in ſo palpable a ſtate, proves beyond a doubt, that the tranſition to acid hath been actually performed before animalization took place.

By the different degrees of denſity of the fat of herbaceous, ſimple carnivorous, and compound carnivorous animals, we may

may perceive the gradual extinction of the acid through thoſe different ſtages, in proportion as they become further removed from the vegetable kingdom.

Dr. Prieſtley hath diſcovered, that vegetables yield a large proportion of nitrous air *; and he hath alſo found ſubſtances perfectly animal to yield no nitrous, but a proportion of fixed air, though the bulk was inflammable †.

He has given a proof of the antiſeptic power of nitrous air, by its having reſtored mice, in ſome degree putrid, to a ſound ſtate, and preſerved them twenty-five days in the middle of ſummer, without any ſmell of putrefaction even at that time ‡. Nothing can more ſtrongly than this ex-

* Prieſtley on Air from Vegetable Subſtances, vol. ii.

† Same book, on Air from Animal Subſtances, vol. ii.

‡ Obſervations on Nitrous Air, Prieſtley, vol. i. p. 123 and 124.

periment

periment ſhew the antiſeptic power of nitrous air; which fact being eſtabliſhed by Dr. Prieſtley, it remains to be proved, that its preſence in greater or leſs quantity, in animal bodies, determines the time they require to become putrid.

This nitrous air, which is yielded by vegetable ſubſtances, and not by thoſe which are perfectly animal, we ſhall alſo find by Dr. Prieſtley's experiments to be produced from ſuch bodies as are in the intermediate ſtate between vegetable and animal, and in greater or leſs quantity, in proportion as they approach, or are removed from the vegetable ſtate.

Eggs contain a proportion of nitrous air*; therefore reſiſt putrefaction a con-

* Dr. Prieſtley does not mention the kind of eggs he made uſe of in the experiment, from which we ſuppoſe them common pullet eggs, as thoſe of carnivorous fowls would not yield nitrous air. Two meaſures of common air, and one from eggs, occupied the ſpace of two and a half.

ſiderable

ſiderable time longer than the fleſh of granivorous fowls.

Milk is rather leſs animalized than eggs, and contains rather more nitrous air*; therefore, under ſimilar circumſtances, reſiſts putrefaction proportionally longer than eggs when broken, which is neceſſary for an equally free contact with the external air.

We have mentioned the fat of animals, as the repoſitory of the vegetable antiſeptic acid. Dr. Prieſtley found, that hog's lard gave a large proportion of nitrous air, which, he ſays, was almoſt as ſtrongly nitrous as that produced from metals: had he tried the firm fat of mutton, or beef, he would probably have found it to yield rather more than the hog's lard, as the

* Two meaſures of common air, and one from milk, occupied the ſpace of two and one-fourth only.—Prieſtley on Air from Animal Subſtances, vol. ii. p. 154 and 156.

bodies

bodies of theſe animals are more immediately formed from the ſimple vegetable qualities. The brain of a ſheep, which is alſo a kind of fatty ſubſtance, yields nitrous air; but from the quantity contained in hog's lard, there is reaſon to ſuppoſe, that the fat of the ſame ſheep would have yielded much more.

Diſtilled water was found to imbibe one-tenth its bulk of this nitrous air, which gave it a remarkable acid aſtringent taſte.

The Doctor's experiments co-operate with thoſe of Mr. Bewley*, to prove that this nitrous air is a certain modification of the nitrous acid with phlogiſton, and that it is deprived of its elaſticity by mixture with common air, or water. Since therefore nitrous air is proved to be a modification of the nitrous acid, and this acid ſo modified is found in vegetable, and not in animal

* Prieſtley, vol. i. p. 317.

bodies,

bodies, except in the fat or medullary parts, it ſeems highly probable, that the antiſeptic qualities of vegetables ariſe from this nitrous acid in their compoſition *.

Beſides the experiments of Dr. Prieſtley, which prove the exiſtence of an acid in vegetables, which he produces in the form of air, the ſame acid, ſtill differently modified, is got by the ſecond fermentation; and by ſimple diſtillation all aceſcent vegetables yield an acid without the proceſs of fermentation, which acid mixes with the water from the plant, and com-

* Mr. Macquer, under the head of Chemical Decompoſition, ſays, that "Sometimes one and the ſame plant "contains ſalts analogous to all the three mineral acids, "which ſhews that the vegetable acids are no other than "the mineral acids, variouſly changed by circulating "through plants."

The mineral acids are generally allowed to be convertible into one another; therefore, although this acid appears under a nitrous form when got from plants, yet it may have been under a vitriolic one when taken up by the vegetables.

municates

municates its taſte in the ſame manner that nitrous air does, when it impregnates diſtilled water*.

Notwithſtanding theſe proofs, it may be ſaid, that the nitrous qualities of the air from vegetables, in Dr. Prieſtley's experiments, reſult from the nitrous acid made uſe of: were this really the fact, nitrous air ſhould alſo have been produced when the ſame acid was employed with animal ſubſtance; but this was not the caſe. It may alſo be alleged, as nitrous air is a modification of the nitrous acid with phlogiſton, that this principle contained in vegetables unites with the acid which is added, and forms the nitrous air got from vegetables. Animal ſubſtances contain the phlogiſton in a more eaſily ſeparable ſtate, and in greater quantity than

* See Macquer's Chemiſtry. To analize vegetable ſubſtances, inſtanced in guaiacum wood.—Vol. ii. chap. vi. proceſs 1.

vegetables;

vegetables; therefore when nitrous acid is added to them, nitrous air ſhould be produced; but this is not found to be the caſe.

There is, we apprehend, every reaſon to believe that this nitrous air is the ſame with the vegetable acids got by fermentation and diſtillation, from all plants except ſome of the alcaleſcent kind; and from finding that ſome of thoſe are ſcarce capable of any ſenſible degree of aceſcency by fermentation *, and that in diſtillation no perceivable acid is got from them †, it is probable, that on trial no nitrous air would be obtained from ſuch plants by Dr. Prieſtley's method.

* See chap. iii. of this part.

† See Macquer's Chemiſtry. To analize vegetable ſubſtances which yield the ſame principles as are obtained from animal matters, inſtanced in muſtard ſeed.—Vol. ii. chap. vi. proceſs 2.

The experiments we have alluded to are clear, and the proofs we draw from them ſeem concluſive, and in the ſtrongeſt manner confirm what we have aſſerted in the former chapters, *viz.* that vegetable ſubſtances, uſed as food, part with their acid when in the ſtate of chyle, which acid is not only found in animal bodies, but is the corrector of putrefaction in them.

There ſubſiſts a very great affinity betwixt the principle of inflammability and the mineral acids, particularly the nitrous; it is therefore probable, that this affinity may be one cauſe which unites the oils of our bodies with the acid ariſing from vegetable food, which, in the form of fat, is lodged in different parts, from whence it can be brought into the ſyſtem as required. It is abſorbed, and ſupplies the place of food when nutriment is wanting, either from diſeaſe or neceſſity; and by its an-

tiſeptic powers it corrects putrefaction, or the natural tendency of bodies to a ſtate of diſſolution. Were this acid leſs powerful, there is great reaſon to ſuppoſe from ſcorbutic caſes, that animal bodies would ſoon run into a putreſcent ſtate. This principle ſeems therefore to regulate the condition of the body: when deficient, it may be ſupplied by the uſe of vegetable food; and when a ſuperabundant aceſcency is prevalent in the ſyſtem, that may be corrected by animal diet *.

† Dr. Prieſtley mentions a circumſtance worthy of attention, relative to the ſolution of aſtringent vegetables in the nitrous acid, ſuch as galls, Peruvian bark, and green tea. They diſſolve with peculiar rapidity, and produce one half fixed air, and the other ſo ſtrongly nitrous, that two meaſures of common air, and one of this, occupied the ſpace of $2\frac{1}{2}$ meaſures. May not the powerful effects of aſtringent vegetables, as antiſeptics, be owing to their rapid diſcharge of theſe acid airs, which in them may be more looſely combined than in ordinary vegetables; and from this cauſe alſo may not their taſte of aſtringency ariſe, which is ſomething ſimilar to nitrous air combined with water?—See vol. iii. p. 170.

CHAP. IX.

The Formation of Butter analogous to the Formation of Fat in Animals.

IF freſh milk from the cow is churned, and the butter it yields be well waſhed from the milky parts, and diſtilled, a ſtrong acid phlegm is got; and when this acid is ſeparated by one or more diſtillations, the oily part becomes fluid. We have obſerved, that the butter made immediately from new-milk, however agreeable to the taſte, is generally very ſoft: this we ſuppoſed to ariſe from a deficiency of the acid, as the butter was obſerved to be much harder when the milk had acquired ſome degree of acidity by ſtanding, of which the following experiment is a proof.

We took a quantity of new-milk, and having divided it into two equal parts, we put

put them in two bottles of the ſame ſize, to the one of which about a third of its quantity of ſtale ſharp butter-milk was added, and both bottles were ſhaken, or churned, at the ſame time: the butter appeared ſooneſt in that which had the ſour milk added; and when they were ſeparated and waſhed, it was alſo much firmer than the other, and would no doubt have yielded a greater proportion of acid, had both been ſubmitted to diſtillation.

The neweſt butter, treated by diſtillation, yields an acid, which muſt have exiſted in the milk before drawn from the animal, as the qualities of milk depend on the properties of the aliments from whence it was extracted.

It is an argument in favour of our opinion, relative to this union being made after mixture with the blood, that the oily

part of the chyle is in a diffuſed ſtate, and its perfect union only effected after it enters the ſubclavian vein *. The above circumſtance appears alſo a proof, that when our nutriment is in its progreſs from the inteſtines to the ſubclavian vein, no acid is then mixed with it in a diſengaged ſtate, otherwiſe its union with the oil might be affected in its courſe through the lacteal veſſels.

The action of the blood veſſels we conceive to be ſimilar to churning, by which the union of the oils and acids is effected in the body, in the ſame manner, and by the ſame cauſes which unite them when out of it.

* See Dr. Cullen's Phyſiology, p. 194.

CHAP.

CHAP. X.

Of Fixed Air.

MR. Bewley's experiments, annexed to Dr. Prieſtley's work, on different kinds of air, prove that mephitic or fixed air either is, or contains an acid *ſui generis*, entirely different from all others. The power of this acid air, as an antiſeptic, is much leſs than nitrous air, yet it acts as a corrector of putrefaction in proportion to its acidity*.

Mr. Cruikſhank, in the poſtſcript to his letter on abſorption, publiſhed with Mr. Clare's eſſay on abſceſſes, wounds, and ulcers, ſpeaks on the ſubject of fixed air in the following words:

" I ſuſpect that it is a particular combi-
" nation of phlogiſton and atmoſpheric air

* See Dr. Dobſon's Medical Commentary on Fixed Air, Sect. 3.

" which forms fixed air. The experiment " in which the air became fixed by the " burning of phoſphorus of urine (the " idea of which was ſuggeſted to me by " Dr. Keir) ſeems to prove this :

" The phoſphorus of urine contains " phlogiſton, and a very fixed acid. In " burning, it therefore gives over the pureſt " phlogiſton to the atmoſphere. As phlo- " giſton, joined to atmoſpheric air, pro- " duces the ſame effect on lime-water as " fixed air, I am led to ſuſpect, that fixed " air, however obtained, is a combination " of atmoſpheric air and phlogiſton, or of " ſomething in ſome reſpects agreeing with " phlogiſton."

Dr. Crawford, in his Obſervations on Animal Heat, pages 32 and 33, expreſſes himſelf on this ſubject in the following words :

" That

" That the fixed air produced in reſpi-
" ration depends on a change which the at-
" moſpherical air undergoes in the lungs
" is, I think, evident from the following
" facts:

" Air is altered in its properties by phlo-
" giſtic proceſſes, and though many of
" theſe proceſſes are totally different from
" each other, yet the change produced in
" the air is, in all caſes, very nearly the
" ſame. It is diminiſhed in bulk; it
" is rendered incapable of maintaining
" flame, and of ſupporting animal life;
" and, if we except a very few inſtances
" where the fixed air is abſorbed, it uni-
" verſally occaſions a precipitation in lime-
" water. We have therefore reaſon to be-
" lieve, that there is no inſtance of a phlo-
" giſtic proceſs in nature which is not ac-
" companied with the production of fixed
" air."

Dr.

Dr. Prieſtley, by taking the electric ſpark over lime-water, occaſioned a precipitation, which not only proves that the air was rendered fixed, but alſo that electric matter and phlogiſton are equally capable of changing atmoſpherical air to fixed air; which ſtrengthens the proofs of phlogiſton and electric matter being the ſame, or modifications of the ſame principle.

Plants depurate air rendered noxious by reſpiration, great part of which is fixed air. The power of vegetables, in abſorbing phlogiſton, is now well known; therefore by their abſorbing this principle from the fixed air diſcharged by expiration, the ſame air is again fitted for the purpoſes of animal life; which ſhews, that it had been rendered fixed by a union with phlogiſton.

We are from the foregoing facts led to ſuſpect, that a part of the fixed air detached

tached from putrid vegetable and animal ſubſtances is formed in their pores, and on their ſurfaces, by the phlogiſton which is continually eſcaping from them uniting with the atmoſpheric air with which they are in contact; hence the preſence of fixed air in theſe bodies may be leſs than the quantities they appear to diſcharge when in a ſtate of putrefaction.

The facility of evolving, or parting with the phlogiſtic principle, ſeems to increaſe in animal matter in proportion as it is further removed from the vegetable ſtate; for we find that the tendency to putrefaction in animal ſubſtances keeps exact pace with the degree of their animalization. Hence there is reaſon to ſuſpect, that the retention of this principle in animal bodies is more ſtrong in proportion as the quantity of acid in them is increaſed; for acid ſeems to be the great retainer of this ſubtile fluid,

by

by the ſtrength of the affinity which ſubſiſts between them.

In Chap. III. of the Firſt Part, we have in general conſidered the air contaminated by reſpiration, or detached from putrid vegetable and animal ſubſtances, as unfitted for reſpiration by the quantity of phlogiſton it contains, reſerving for this place a more full proof of the formation of fixed air, by a union of phlogiſton and atmoſpherical air.

CHAP. XI.

Of Vegetable Food of the Firſt Claſs.

A DIET of vegetables, entirely of the firſt claſs, is the moſt difficult of any to digeſt and aſſimilate, not only from their texture, but being furtheſt removed from the nature of animal matter, by having one at leaſt, if notboth of the fermentations

ations previous to putrefaction ſtill unperformed. From theſe cauſes they are retained long in the ſtomach and inteſtines, before they yield their nutriment to the lacteal veſſels. The chyle from them is thin and watery, and much leſs corroborating in hot than temperate climates.

Thoſe who live wholly on vegetables, even aſſiſted with a cold climate and exerciſe, are, generally ſpeaking, ſhorter lived, and in the decline of life fall off much faſter than others who have uſed a proper quantity of animal food*. The ſame obſervation holds good in a ſtill higher degree in warm climates; they co-operate with ſuch food, in relaxing and debilitating the body, the juices of which muſt under thoſe circumſtances be poor and thin.

* This obſervation is made by Sir John Pringle.

CHAP. XII.

Of Vegetable Food of the Second Claſs.

THE vegetables of this claſs, as we have already mentioned in Chap. III. may have their alcaline acrimony diſſipated by coction; but even when in this ſtate, they become putrid much ſooner than vegetables of the aceſcent kind. They are however totally incapable of ſupporting the human body, as the nutriment they yield is very trifling. Their principal utility conſiſts in promoting the digeſtion of other vegetables in the ſtomach when uſed with them. Their ſtimulating powers when raw aſſiſt digeſtion; and hence the aromatic and alcaleſcent plants are much uſed in this ſtate by thoſe who live principally on vegetable food,

food, particularly in warm climates. They act in ſome degree like animal ſubſtance, by abſorbing the acidity from vegetables of the firſt claſs, which accelerates their diſſolution. From Sir John Pringle's experiments, the ſaliva mixed with vegetable aliments, prevent efferveſcence even out of the body, although the vegetable matters notwithſtanding go through the different ſtages; therefore it is, that in healthful bodies, nouriſhed with a due proportion of animal food, the ſaliva and ſtomachic juices prevent eructations; but when animal matter is wanting, the alcaleſcent plants are in the ſame way uſeful. In weak ſtomachs, and poor thin habits, eructations from a want of ſuch correctors are common. This effect is produced by a mixture of every kind of animal matter with vegetable food; and the more animalized the matter is, the more powerfully will it act in diminiſhing efferveſcence, by abſorbing

abſorbing the acid as ſoon as formed; and in the ſame manner do the alcaleſcent plants act when boiled, by becoming putrid ſooner than thoſe of the aceſcent kind.

CHAP. XIII.

Of Half Animal Food.

THE milk of herbaceous animals we conſider as the chyle ſecreted from the blood, with this difference, that when in the ſtate of milk it is more animalized than when in the lacteal veſſels, as it hath undergone an intimate mixture with the blood, previous to its ſecretion, by which its aſſimilation when taken as food will be more eaſy than if uſed for the ſame purpoſe when in the ſtate of chyle*. For

* Omnia fere animalia recens nata lacte nutriuntur; quod partes alibiles, per corporis animalis organa preparatas, continet, et ſine ulla maſticatione in chylum facile convertitur.

theſe

theſe reaſons it becomes a good, quick, and eaſy digeſted nutriment, without that difficult and tedious extraction of the chyle, which retards the digeſtion of vegetable food, though it ſtill retains thoſe aceſcent qualities which give vegetables the power of correcting putrefaction*.

CHAP. XIV.

Of Simple Animal Food.

IT hath been already ſeen what proceſs vegetables go through, in the courſe of their digeſtion and aſſimilation, from which, the cauſe of their ſlow converſion into animal ſubſtance is readily underſtood. It now remains to ſhew, wherein the difference between the digeſtion and aſſimila-

* Lac eſt nutrimenti genus inter vegetabile et animale, ab humano genere univerſaliter uſurpatum, et omni ætate adoptatum.

Dr. Young de Lacte, Pars II. Caput 1. Sect. 1.

tion of ſimple animal food, and vegetable matters, conſiſts.

Animal ſubſtances, from having undergone the two firſt fermentations, are as far advanced in aſſimilation when broken down and macerated in the ſtomach, as the chyle from vegetables of the firſt claſs is, when mixed with the blood, after having undergone the diſcharge of its acid.

From this advanced ſtate of animal matter, its aſſimilation is eaſy, and from its texture and ſolubility, its digeſtion is alſo accompliſhed with little difficulty.

Animal ſubſtances have for theſe reaſons effects very different from vegetables; the latter are antiſeptic in proportion to the acid they produce, while the former being paſt that ſtate, are no longer correctors of putrefaction; but in animal heat, run directly

rectly into it with conſiderable rapidity, unleſs that tendency is counteracted.

It is evident that animal food muſt be more ſtrengthening than vegetable, as it is made up of the nutritious parts of vegetables only, concentrated and prepared for eaſy union with living bodies.

Animal ſubſtance as a conſtant food is ill fitted to the human frame: a continued uſe of it without vegetables muſt ſoon end in putrefaction, as the only correctors of its tendency then left, are motion and air; the effects of which laſt as a corrector of putrefaction in living animal bodies, we ſhall hereafter ſhew to be greater or leſs according to climate.

Animal ſubſtance, by being the moſt ſtrengthening food, becomes its own corrector, by increaſing the ſtrength of the ſolids,

and conſequently quickening the motion of the fluids. This to a certain degree is ſalutary; but if carried further, putreſcency brings on relaxation, diſeaſe, and death.

The circulation of the blood in herbaceous and granivorous animals is moderate and often languid; their tempers are docile, mild, and timid. In carnivorous animals circulation is quick, and their tempers are often violent and fierce, unleſs when thoſe effects of food are counteracted by climates, either very hot or exceedingly cold, as we ſhall hereafter mention more fully in the Third Part.

CHAP. XV.

Of Compound Animal Food.

THE digeſtion of this kind of animal ſubſtance is eaſy and quick. Such animals as live on food of this ſort have exceeding little action of ſtomach.

Fiſh

Fiſh are the common food of fiſh, and their diſſolution is eaſily accompliſhed by the juices of the ſtomach, which ſeem to act as a menſtruum.

The facility of digeſtion, and abundant nutriment which this kind of food affords, is generally conſidered as the ſource of that high health, and thoſe numerous families among the inhabitants of the ſea-coaſt.

Vipers ſwallow their food whole, which are animals, and many of them in ſome degree carnivorous, ſuch as rats, mice, lizards, &c.; theſe reſt in the body until ſoftened, and melted down by the heat and animal juices. From the nature of their feeding, and this manner of digeſtion, they ſtand high in the rank of compound animal food. This ſpecies of animal ſubſtance is therefore of quick and eaſy digeſtion, and the nutriment from it, not only very great, but of ready aſſimilation.

Common ſnakes, which feed on herbage, poſſeſs none of theſe qualities in any higher degree than ſimple animal ſubſtance. In caſes where much nutriment is wanted in a ſmall volume, and eaſily digeſted ſtate, fiſh and vipers are moſt proper: the milk of carnivorous animals, which is very near the ſtate of compound animal food, might be found proper alſo for this purpoſe.

All the conſequences will follow a diet of this kind, in promoting the general tendency to putrefaction, which hath been mentioned as the effect of ſimple animal food, only in a higher degree, and ſhorter time, if taken in the ſame climate in equal quantities, without proper correctors.

The rapid progreſs to putrefaction in highly animalized bodies ariſes from a more perfect extinction of all the antiſeptic qualities of the vegetables which went to form the

the original body; and the further they are removed from that ſtate, the more quickly do they become ſoft and putrid, and conſequently the more eaſily are the lean parts brought into a digeſtible ſtate. The oily parts of all animals are moſt difficult of digeſtion, and thoſe of the moſt animalized are the moſt ſo, from their greater want of acid; therefore when fiſh and vipers are directed for weak habits, the lean only ſhould be uſed. With ſuch food acids are highly proper, and hence the great propriety of uſing much butter-milk where fiſh is the common food.

The fleſh of herbaceous animals, ſuch as cattle, ſheep, &c. reſiſts putrefaction, under equal circumſtances of heat and moiſture, longer than the fleſh of dogs who have been nouriſhed with animal food. It is well known that the fleſh of carrion crows, ſea fowls, and fiſh of all kinds, will be-

come putrid ſooner than either of the above animals. Mr. Reaumur has obſerved that unimpregnated eggs reſiſt putrefaction much longer than impregnated ones: the cauſe of this difference ariſes from the ſemen of the male being a highly animalized matter, and therefore runs ſooner into putrefaction, and acts as a ferment, which induces the ſame through the reſt of the egg.

CHAP. XVI.

Of the Inteſtines.

ANIMALS that feed on herbage have very long inteſtines, purpoſely to extract the whole nutriment before the fæces are diſcharged. Simple carnivorous animals have inteſtines much ſhorter, while thoſe which feed on compound animal food, ſuch as fiſh, have their inteſtines the ſhorteſt of all. On examination, we ſhall generally

rally find the length of the inteſtines in different animals, proportioned to the difficulty and ſlowneſs with which the chyle is extracted from their food.

By this method of determining the proper food of animals, the human ſpecies ſeem intended by nature for a mixed aliment; and in concluſion it will appear more than probable, that a mixture of animal food in all latitudes is the moſt ſalutary, varying in proportion according to climate.

CHAP. XVII.

Of the Solvent Powers of the Stomachic Juices.

THAT the ſolvent powers of the ſtomachic and gaſtric juices are in every animal peculiarly fitted by nature to diſſolve and promote the digeſtion of their particular

particular food, is an opinion which hath lately gained ground: this we ſhall endeavour to reconcile to our theory of digeſtion, by ſhewing how the qualities of the menſtrua in the ſtomachs of different animals, reſult from the properties of the food they have lived on. The above opinion relative to the ſolvent powers of menſtrua, is founded principally on the following facts;

Carnivorous animals do not digeſt vegetable aliment ſo ſoon as animal food; and herbaceous animals digeſt animal food with ſtill greater difficulty.

In anſwer to the firſt it muſt be obſerved, that the fluids of animals perfectly carnivorous have a ſtrong tendency to putrefaction, which will accelerate the fermentations when mixed with vegetable aliment*; but it is alſo to be obſerved, that the ſame

* See Sir John Pringle's experiments.

tendency

tendency does at the ſame time promote the diſſolution of animal matter exceedingly, when taken into the ſtomach; and as this kind of food is nearer to a ſtate of diſſolution than vegetables are, its digeſtion is accompliſhed before vegetable aliments have undergone the changes neceſſary to make them yield their nutriment.

In anſwer to the ſecond argument it muſt be conſidered, that the ſtomachs of herbaceous animals have at all times a ſtrong acidity in them, as the juices they contain are thoſe of vegetables only; and hence it is that when fiſh or fleſh is given to a ſheep or other animal perfectly herbaceous, it has been found in the ſtomach unaffected, while turnip and other vegetable ſubſtances given at the ſame time were diſſolved: this reſults from the acid in the ſtomach, which on animal matter acts as an antiſeptic, but at the ſame time induces the fermentations

in vegetable food when taken into the ſtomach.

This is exactly conſonant to the experiments of Sir John Pringle, who found that putrid animal matter ſoon induced the firſt fermentations when mixed with vegetables, but that the acid produced thereby, was ſo powerful an antiſeptic, as totally to ſubdue the putreſcency in the very animal matter itſelf, which had actually induced the vegetable fermentations. Hence it may be ſuppoſed, that if a piece of tainted animal ſubſtance were given to a ſheep or cow, it would in a few hours afterwards be found ſweetened by the acid of the ſtomach. We ſuppoſe that a Canadian cow, which has been for ſome time fed on dried fiſh, would digeſt animal matter nearly as eaſily as a carnivorous animal; and that the ſtomach of a dog, which had been for a conſiderable time entirely nouriſhed by vegetables, would preſerve

preſerve fiſh or fleſh nearly as well as that of an herbaceous animal.

The following caſe communicated to us by a celebrated practitioner is exactly in point:

A gentleman troubled with ſtomachic and other complaints, found vegetable food of difficult digeſtion; a vegetable diet was directed, in which he perſevered, and in time found his complaints removed, and the digeſtion of that kind of food perfectly eaſy. Having for ſome years continued a vegetable diet, he thought of returning to the uſe of animal food; but by the change he found a return of his complaints. This ſeems to have reſulted from a want of that ſpeedy diſſolution of the animal matter in the ſtomach, which would have taken place, had it not been counteracted by the prevalence of the acid that aroſe from his

his long continued uſe of a vegetable diet.

By the above reaſoning, it follows that the ſolvent powers of the animal fluids reſult not from any particular organization of the bodies themſelves, but are the effect of food, and may in the ſame animal be changed by a continued uſe of foods of oppoſite qualities.

CHAP. XVIII.

Of Propenſity to particular Foods.

THOSE who live ſo much on animal food as to have their bodies in a too highly alcaleſcent ſtate, as it is called (by which is meant a ſtrong tendency to putrefaction), have a great propenſity for antiſeptics; wines, fruits, and acidulated drinks of all kinds are particularly agreeable to them.

When

When a putreſcent tendency is induced by ſtopped perſpiration or otherwiſe, there is frequently the moſt ardent deſire for powerful antiſeptics, which are ſwallowed with avidity, and often in aſtoniſhing quantities. In putrid fevers, many bottles of the moſt aſtringent claret are ſometimes drank, before the propenſity ſubſides. Of this kind are the longings in the ſcurvy for aceſcent vegetables and ſummer fruits. When this is the caſe, the thing wiſhed for ſeldom fails to produce the deſired effect.

How ſuch a particular ſtate of the body points out the proper remedies for relief, may we apprehend be in ſome degree underſtood, by conſidering ſuch a ſtate as a derangement or variation from a ſound condition of body: in this way a painful ſenſation is communicated, like that of hunger or thirſt, by which ſenſation the

remedy

remedy may be indicated as much as in the caſe of hunger and thirſt.

When a vegetable diet hath been long uſed, the fluids are thinned, and the relaxed ſolids become ſoft: under ſuch circumſtances, the propenſity to animal ſubſtance is very ſtrong. The oils from animal food, and every part of animal matter, by their putreſcent tendency, are fitted to abſorb and unite with the ſuperabundant acid*; by which the proportion of this principle is diminiſhed, and the body returned to a ſound condition.

In the ſouthern climates this is moſt remarkable, from the heat co-operating with a continued vegetable diet to relax the ſolids, and keep the fluids in an uncondenſed and ill aſſimilated ſtate. Perſons in this condition eat moſt greedily of all kinds

* See Sir John Pringle's experiments.

of

of animal food, not excepting the carnivorous animals themſelves, ſuch as dogs, cats, &c. and they generally give a preference to theſe and tainted animal ſubſtance, from an inſtinctive knowledge, that it will more readily counteract the ſuperabundant aceſcency of their fluids, than fleſh in a ſound ſtate*. Such food is harmleſs and even healthful to thoſe perſons, though it would be productive of the worſt conſequences in bodies that had been nouriſhed by a due proportion of animal matter; as in thoſe, it would increaſe the alcaleſcent or putreſcent tendency beyond the due bounds conſiſtent with good health †.

The

* Every overſeer in the Weſt-Indies knows, that the negroes who cultivate the ſoil, and live almoſt entirely on vegetables, prefer ſalted and tainted meats to thoſe which are freſh and ſound.

The poor inhabitants of China, who live principally on rice and other vegetables, are remarkable for eating animal ſubſtances of all kinds with great avidity, even when in almoſt the laſt ſtages of putrefaction.

† From this we may obſerve how the body at ſome times reſiſts infection, and at others, when in a more animalized ſtate, becomes more ſuſceptible of it.

The inhabitants of ſome parts of the Eaſt-Indies, whoſe religion forbids the uſe of animal food, and are therefore confined to milk and vegetables, have not probably theſe propenſities: as they never taſted fleſh, therefore they can have no idea of its effect; for it is to be obſerved, that thoſe propenſities are fixed on ſuch things as we are acquainted with the taſte of, or are ſimilar in appearance to ſuch things as we know by taſte. This, together with the ſtrongeſt prejudices of education, counteracts in them a propenſity ſo natural to thoſe who are accuſtomed to the uſe of animal food, and

Dr. Alexander in his Enquiry ſays, that from the various animal food uſed in different countries when in a putreſcent ſtate, 'one would be tempted to think that there is no difference in aliment, and that the ſtomach is endowed with a power of extracting good and wholeſome chyle from every kind of it, in every ſtate in which it can exiſt.'

This we ſhall endeavour to prove is by no means the caſe; and that when ſuch food is harmleſs, it ariſes from the general food of the perſons being vegetable, or from the particular pure unimpregnated ſtate of the atmoſphere in which they live.

have

have no prejudices to conquer; though the ſame propenſity may in ſome degree be indulged, by the uſe of alcaline and aromatic plants *.

CHAP. XIX.

Motion a Corrector of Putrefaction.

IN the frigid zone, for the greateſt part of the year, animal bodies are in a leſs putreſcent ſtate after death than before it. This

* Dr. Alexander, in ſpeaking of the proclivity towards putrefaction, 'We muſt, ſays he, rather judge from the quality of thoſe juices ſo far as we can diſcover their qualities; and in forming this judgment, the more crude, watry, and indigeſted, and the leſs animalized thoſe juices are, it will, cæteris paribus, be preſumable to ſuppoſe the animal the more liable to putrid diſeaſes; and this coincides with the obſervations of ſeveral of the beſt practical authors, who have generally agreed that ſuch people as were debilitated either by former diſeaſe, low, poor living, &c. were the moſt ſubject to putrid diſeaſes, and the ſooneſt overcome by them.'

This reſults from the difference of temperature in dead and living animals; but while animals are alive, motion may undoubtedly be conſidered a corrector of putrefaction, as by it the circulating fluids are enabled to diſcharge the putreſcent matter which is continually generated in the body.

CHAP. XX.

Effect of Air on living Animal Bodies.

IN the Firſt Part we have endeavoured to point out the different effects of climate and air on vegetables; we ſhall now take a view of their influence on animal bodies; but before we begin, it ſeems neceſſary to

Theſe practical obſervations are juſt, but they do not admit the above inference; for it is evident beyond doubt, that the more animalized any body is, the ſooner it will run into putrefaction; yet putrefaction is often induced from debility and want of motion, as we ſhall hereafter point out in Chap. XXIII.

premiſe

premiſe a general idea of the effect of air on animals by reſpiration.

Among the diſcharges or excretions from the body, that by the lungs ſeems leaſt attended to, and hath been frequently conſidered of little importance as an evacuation. Dr. Keill and Dr. Hales found that a man in twenty-four hours loſt by perſpiration thirty-one ounces, ſix of which ounces went off by expiration, and this Dr. Hales ſays he has found, by certain experiment, to be ſo much, if not more. A ſmall increaſe or diminution of this diſcharge muſt be attended with evident conſequences; and although the diminution of one excretion generally increaſes another, without inconvenience or uneaſineſs to the body, yet we apprehend that the excretion from the lungs, cannot in a very great degree be diverted into another channel.

Air is the medium by which the lungs are enabled to make their diſcharge; but air is capable of receiving only a certain impregnation, and of carrying off but a certain quantity of moiſture and putrid effluvium, which quantity depends on the ſtate of its impregnation at the time it is reſpired. When it is extremely dry and well dephlogiſticated, it will carry off a great charge from the lungs; but when it is highly impregnated, it will carry off very little, and if ſaturated it will not free the lungs at all.

Suffocation is immediately the conſequence of reſpiring air ſaturated with the phlogiſtic principle; its effects are exactly the ſame with a total want of air, as in both caſes the lungs get no relief by any diſcharge.

Dr. Crawford, by his ingenious publication on Animal Heat, has ſhewn that the diſcharge

diſcharge of the phlogiſton by the lungs is neceſſary to the ſupport of that heat; as this principle is received by the atmoſpherical air taken into the lungs at each inſpiration, from which it precipitates a certain quantity of heat; and the ſame air which has been deprived of its heat, goes off by expiration charged with phlogiſton.

CHAP. XXI.

Theory of the Operation of putrid Effluvium from Marſhes.

THROUGH the foregoing chapters we have endeavoured to prove that animal bodies have a ſtrong natural tendency to putrefaction, and would actually run into it, unleſs prevented by the diſcharge of their moſt putreſcent parts.

In all animal bodies there is evidently a large proportion of phlogiſton; and the more animalized they are, the leſs fixed is this principle, or in other words, the more abundantly is it evolved.

Dr. Prieſtley in his third volume on Air, before the publication of Dr. Crawford's Experiments on Animal Heat, had ſhewn that air inhaled by inſpiration received a charge of phlogiſton from the blood, which was diſcharged by expiration. This evacuation to a certain degree is abſolutely neceſſary to the exiſtence of the human ſpecies; therefore when the diſcharge is leſs copious than the quantity of this principle evolved, it muſt accumulate and bring on a general tendency to putrefaction. But the accumulation may ariſe from two different cauſes, viz. either too much highly animalized food, or an air which is ſo much impregnated, as not to be able to receive a ſufficient

ſufficient quantity from the lungs, while perſpiration is too limited to make up for this deficiency. Either of theſe cauſes will occaſion an accumulation, and both will produce the ſame effects unleſs corrected.

Dr. Alexander hath given an account of ſeveral experiments which prove deciſively, that effluvia from marſhes act as antiſeptics and correctors of putrefaction; from which, he ſeems to doubt if they operate in inducing putrefaction in living animal bodies. Daily experience contradicts this idea; but to reconcile the antiſeptic qualities of the exhalations from putrid marſhes on dead animal ſubſtance, and their known effects in bringing on a putreſcent tendency in living animal bodies, ſeems difficult, yet the following ſolution appears probable.

All marſhy grounds and ſtagnated waters emit a ſmell more or leſs diſagreeable, from

from the vegetable ſubſtances which ferment and rot in them; this mixture of humidity, fixed air, and putrid vapour, contains a certain degree of phlogiſton in this climate*; but in the warm ones, where theſe effluvia are moſt dangerous, they muſt contain it in a much larger quantity, as putrefaction is there more rapid.

Thoſe vapours impregnate the ſurrounding atmoſphere, and diſable it from carrying off from the lungs, the putrid vapour and phlogiſton in ſuch abundance as may be neceſſary to prevent an accumulation in the body; in conſequence of which, putrid diſeaſes come on, not from the matter taken into the body, but from that retained which ought to be expelled, and would actually be ſo in a purer air. In this ſeems to conſiſt the great difference between the action of

* See Dr. Prieſtley on Air from putrid Marſhes, in a letter to Sir John Pringle, vol. i. p. 198.

putrid

putrid effluvium on dead and living animal bodies; and the ſame cauſes which will occaſion this retention, may act very differently on dead animal ſubſtance, in which there is no continued evolution of the phlogiſton until the whole maſs of animal matter tends to a ſtate of diſſolution.

Dr. Alexander mentions the moiſture of the air near ſuch places. This circumſtance muſt have great weight, by moderating the perſpiration at a time when it ought to be increaſed; and from the co-operation of the ſuppreſſion of this diſcharge, with that from the lungs, we ſuppoſe the diſpoſition to putrefaction is produced; for it is not to be doubted that a free perſpiration will give relief, when reſpiration is laborious; and that an undue diſcharge of perſpiration will affect the lungs by flinging a greater load on them. That particular ſorts of deleterious matter muſt be taken into the body

body to produce their effects, is undoubted; ſuch is that of the ſmall-pox, from the air of a room in which there is, or has lately been a patient with the diſeaſe. The plague hath alſo been conveyed to great diſtances in folds of cloth; but theſe are poiſons, and ſome of them ſo active, from the very high degree of acrimony which they have acquired, as to produce the moſt immediate effects on the nervous ſyſtem, independent of their action as ſeptics. Theſe differ widely from the exhalations above mentioned, which ariſe from vegetables, and are taken into the body in ſuch vaſt quantities in marſhy ſituations, as would effectually produce the moſt rapid putrefaction were they in any degree ſeptic.

The airs of the vegetable fermentations which are known to be highly antiſeptic, we ſuppoſe, mix in ſuch a manner with the putrid

putrid exhalations as to ſubdue their effects, and give thoſe antiſeptic qualities which Dr. Alexander has ſhewn them by experiment to poſſeſs, when applied to animal matter. The Doctor himſelf has adopted this idea to account for the conſequences of his own experiments, by which he found, that infuſions of vegetables in water, and even cabbages and ſtrawberries, after emitting a putrid ſmell, were ſtill powerful correctors of putrefaction in dead animal matter. The ſtrong antiſeptic qualities of the airs diſcharged by the vegetable fermentations, ſeem fully to counteract the ſeptic tendency of the putrid effluvium from marſhes, when applied to dead animal ſubſtance, even ſhould there be ſmall portions of putrid animal matters, in ſuch ſwampy or marſhy grounds; yet theſe ſubſtances will exceedingly contribute to the impregnation of the air, and conſequently to its bad effects on living animal bodies, by reſpi-

ration, in the manner we have above mentioned.

This appears in a ſtrong point of view, when we conſider that fixed air is unfit for the purpoſes of reſpiration, though an antiſeptic of very conſiderable efficacy.

CHAP. XXII.

Of putrid Animal Matter taken into the Circulation.

PUTRID animal matter, mixed with the fluids of living animals, gives them a greater or leſs tendency to putrefaction, in proportion to the degree of putreſcency at which it hath arrived; and the more animaliſed the putrid matter is, the higher degree of acrimony and virulence is it capable of acquiring in the ſame time.

The

The following experiments made by Dr. Deidier, with the bile of perſons who died of the plague at Marſeilles 1721*, ſet this matter in a clear point of view.

A drachm of bile, taken from a patient who died of the plague, mixed with water, was injected into the jugular vein of ſeveral dogs; they ſoon became ſtupified, and died with gangrenous inflammations. Some of the blood of a patient who died of the plague, was put on a wound made on the crural vein of a dog, and covered with a dreſſing, which the dog got off in the night; he had licked the wound, but gave ſigns of approaching death towards night. The morning after, he was found dead, and ſwelled, and the wound alſo ſwelled, and gangrened.

* Phil. Tranſactions abridged, vol. vii. part iii. p. 165—168.

A dog

A dog that followed the ſurgeons when they went to dreſs the ſick, uſed greedily to ſwallow the corrupted glands, and dreſſings, charged with the pus, which they took off the plague ſores; he alſo licked up the blood ſpilt on the ground in the infirmary; this he did for three months, yet was always briſk and well. A mixture of one drachm of peſtiferous bile with two ounces of water, was injected into the crural vein of this dog; he became dull and ſtupid, and died like the reſt, on the fourth day, with a bubo on the wounded thigh, gangrened. Dr. Deidier adds, that particular notice was taken, that after the injection, while this dog was living, and alſo when opened after death, he had a very ſtinking ſmell, which was not obſerved in any of the others.

Animals provided with proper ſecretory veſſels for collecting a poiſonous juice, are more

more or leſs dangerous, in proportion to the quantity of animal food they eat, and time of its ſtagnation in the organs of ſecretion. Common ſnakes, that feed on herbage, are harmleſs; and however ſmartly their bite may be felt at the time it is given, the conſequences never go further than local inflammation. This is alſo the caſe with bees, waſps, &c. whereas the bite of vipers, perfectly carnivorous, is in the higheſt degree dangerous.

We ſhall, on examination, find, that the ſymptoms of, and conſequences from, the viper's bite, are the ſame with the peſtiferous bile mentioned in the above experiments.

Animals who live any time after being bit by the viper, turn black, and have all the appearances of approaching mortification; and even thoſe which die in the

ſhorteſt time, have always gangrenous appearances round the wound *, like thoſe in the experiments made by Dr. Deidier. The rattleſnake is the moſt dangerous of this tribe; his firſt ſting is often mortal to dogs in leſs than one minute; whereas the ſucceeding bites are leſs fatal †, and if the poiſon is ejected immediately after ſecreted, it ſeldom proves mortal. This is a proof that the virulence of their poiſon is increaſed by ſtagnation in its proper receptacles; but what makes it in the higheſt degree evident, is, that their bites not only kill one another, but even themſelves, when enraged, and made to wound their own bodies. This ſhews that their poiſon is in a much higher ſtate of acrimony than the other fluids of their bodies; and that this difference may depend more on the

* Phil. Tranſactions abridged, vol. x. page 62.

† Phil. Tranſactions abridged, vol. vii. part 3. pages 46 and 47.

time

time of its ſtagnation, than actual virulence at the time ſecreted, ſeems highly probable from what we have juſt mentioned, viz. that the poiſon newly ſecreted ſeldom kills, but is virulent in proportion to the time of its ſtagnation.

The matter in Dr. Deidier's experiments, and the poiſon of the rattle-ſnake, are alſo ſimilar in another reſpect; which is, that both, when taken by the mouth, are innocent. This probably ariſes from their acrimony being too great to be admitted by the abſorbent veſſels; and it is therefore moſt likely, that theſe poiſons paſs through the inteſtinal canal, without being at any time taken into the circulation. Had the dog, who followed the ſurgeons, actually mixed with his circulating fluids the quantities of putrid matter he ſeems to have ſwallowed, it muſt, we ſuſpect, have brought on, in a very ſhort time, the

ſtrongeſt and moſt general putrefaction; yet the extraordinary ſmell from this dog ſeems to make it appear that he was in a more putreſcent ſtate than the others, who had not been accuſtomed to eat ſuch putrid matter; but it is probable, that this ſmell proceeded from the inteſtines, after their motions were deranged by the poiſon which was injected. No experiments hitherto made, that we know of, have exactly marked the time bodies killed by the bite of a viper take to become putrid, comparatively with another of the ſame kind, killed at the ſame time by other means; but from the ſwelling of ſuch animals very ſoon after death, and the mortified appearances round the wound, and ſometimes general blackneſs, there is little room to doubt that putrefaction muſt come on more rapidly in them, than where no ſuch putrid ferment hath been communicated to the body.

The

The matter injected by a viper into a wound, muſt from its extreme acrimony act inſtantly on the nerves, which is rapidly communicated to the whole ſyſtem; for in no other way could ſuch ſudden conſequences be produced. Its action as a ferment requires more time, and is a very powerful, though a ſecondary one.

CHAP. XXIII.

Of Vegetable Food in hot Climates.

EXERCISE, and the vegetable correctors of the ſecond claſs, which, as hath been already obſerved, act in ſome degree like animal food, will keep the body tolerably ſtout in warm climates, as the atmoſphere in thoſe climates is more charged with phlogiſton than the air of more northern latitudes. It is therefore leſs capable of promoting a copious diſcharge by

the lungs, but perſpiration is increaſed to make up for its deficiency; yet notwithſtanding the quantity of this diſcharge by the ſkin, that very warmth which promotes it, gives the whole body a ſtrong tendency to putrefaction, which corrects the effect of vegetable food, by rendering the animal juices more capable of abſorbing the ſuperabundant acid. The digeſtion of a continued vegetable diet, is by that tendency much promoted; yet in warm climates where animal food is totally wanting, a continued vegetable diet will relax the body ſo much, that putrefaction frequently follows from a weak and languid circulation. In ſuch caſes the ſmalleſt wound becomes a ſore, and a thin, ſharp, acrid, and putrid humour gleets continually from the mouths of the relaxed veſſels; tumors are formed by the ſtagnating fluids, which break and become ulcers; and theſe continued drains prolong the life, by diſcharging the

the putreſcent matter, which would otherwiſe accumulate. This condition of the body from relaxation only, has, we ſuppoſe, given riſe to the idea of a vegetable ſcurvy, which implies a kind of contradiction; but give it what name we will, it is a general putreſcent ſtate of the body, though ariſing from cauſes exceedingly oppoſite to that of the true ſcurvy.

A negro who had been afflicted for ſeveral months with ulcers of the above kind, and exceedingly emaciated, was carried into the Plantain walk*, or public garden of the plantation, that he might be abundantly ſupplied with vegetable food, and live at his eaſe, which ſeemed the only means of preſerving his life; this had not the deſired effect, for when we ſaw him he had been there near two months, and became worſe than when brought to it. He was now removed from this place, and provid-

* Plantains are a fruit uſed in the Sugar Colonies for bread.

ed with ſalt beef and ſalt fiſh, of which when well boiled he eat three times a day, and was made to move about, and to increaſe his exerciſe daily as his ſtrength would permit. We muſt here obſerve, that a putrid tendency from the above cauſes is productive of the ſame dull, inactive ſtupor, which are the conſequences of the true ſcurvy; yet ſo oppoſite is it to that diſeaſe, that thoſe affected with it have a ſtrong propenſity to animal food, and abſorbent earths, which they eat with great avidity, from an inſtinctive knowledge that theſe will correct the aceſcent ſtate of their fluids. This patient's ulcers were every day bathed with a ſtrong decoction of bark, to which a little rum was added; after this they received no other dreſſing than ſome powdered bark ſprinkled over them. In ten days a viſible alteration appeared in his ſtrength and ſpirits; his ulcers after this began to look better, in ſix or ſeven weeks they were quite filled up, and in leſs than

three

three months were perfectly well, and the negro ſound, and fit for eaſy work. After the firſt three weeks his deſire for animal food diminiſhed greatly, and as he got ſtrength he returned to his former appetite.

We have mentioned this inſtance, as it was particularly attended to, though all the attempts we have ſeen made in ſimilar caſes, predicted an iſſue equally favourable; but the want of attention in thoſe climates often fruſtrates cures which require ſo much time and care.

It is very common in the Sugar Iſlands, when a negro falls into this habit, and is much reduced, to ſend him on board ſome ſmall coaſting veſſel, where he generally gets well by being obliged to move about, and having an abundant ſupply of beef, fiſh, and other animal food.

CHAP.

CHAP. XXIV.

Of the Feeding of the Negroes in the Sugar Colonies.

IT is unfortunate for the negroes of the ſugar iſlands, that their maſters have been ſo generally impreſſed with an opinion that animal food is hurtful, and productive of ſores; this has originated from miſtaking the ſores above mentioned for the true ſcorbutic ones.

When errors are of long ſtanding, it is exceedingly difficult to eradicate them, particularly in a climate where every mental exertion ſeems intolerable.

Domeſtics in the Sugar Colonies eat more animal food than the labourers, and are in conſequence much leſs ſubject to ſores; wounds

wounds or ſcratches on them cure eaſily; and they are obſerved to be more healthful, and live to greater ages, than thoſe who cultivate the ſoil.

Did the proprietors of eſtates give a more ample allowance of animal food, their negroes would be more vigorous, and live longer; for there is not the ſmalleſt danger of the real ſcorbutic ſores from an enlargement of this kind.

Fiſh, as a compound animal ſubſtance, is better than an equal weight of beef; it is a more animalized body; and therefore a leſs quantity of it will counteract the effects of a crude vegetable diet.

CHAP.

CHAP. XXV.

Negroes leſs ſubject to putrid Epidemics than the White Inhabitants of the Sugar Colonies.

WHEN putrid diſeaſes are prevalent, either from cloſe hot weather, in the latter end of the wet ſeaſon, or from low marſhy ſituations, the white people ſuffer exceedingly, and numbers of them are annually carried off with the higheſt ſymptoms of putrefaction; but in ſuch ſeaſons, and at ſuch places, the negroes are ſeldom known to ſuffer, or be ſubject to ſuch attacks. This ſeems evidently the effect of their food; the continued vegetable diet acts as a conſtant corrector of putreſcent tendency *, and prevents the ſame

* Dr. Lind on the Scurvy. He obſerves, that Venice, though in a very damp ſituation, yet the ſcurvy is there unknown.

ſame cauſes from producing the ſame effects in them, which they occaſion on others whoſe bodies are in a more animalized ſtate.

What proves this in a ſtill ſtronger manner is, that negro domeſtics, who live much on animal food, are as ſubject to putrid epidemics as the white inhabitants.

CHAP. XXVI.

Of Vegetable Food in cold Climates.

THE digeſtion of a vegetable diet in a cold climate, has leſs aſſiſtance from the putreſcent tendency of the body, in proportion as the degree of cold is increaſed; and the atmoſphere of ſuch cli-

known. This he attributes to the heat of the climate elevating the vapours to a great height, or to the great quantities of vegetables eaten by the Italians. Both theſe cauſes may operate; but perſpiration, and the laſt, will, doubtleſs, prevent a tendency to putrefaction.

mates, from the ſlow progreſs of putrefaction in them, is leſs impregnated or phlogiſticated in the ſame proportion. The human conſtitution is ſuch, that different cauſes produce on it the ſame effect, and different climates produce theſe different cauſes, which counteract their improper influence.

The leſs tendency the atmoſphere of any climate has to promote putrefaction, the greater is the degree of cold in that climate, which in proportion braces and ſtrengthens the body. This vigour accompliſhes, in the digeſtion of vegetable food, what an impregnated atmoſphere, and ſtronger putreſcent tendency of the body, does in warm climates; and hence, in cold regions, an entire vegetable diet is not ſo injurious to the ſtrength, as in the warm ones.

In the cold, although the food may not be aſſimilated in much ſhorter time, yet the

the climate counteracts its relaxing tendency, by ſtrengthening muſcular force, and quickening the motion of the fluids; whereas, in the warm latitudes, from the want of this natural and powerful corrector, a looſe texture of the ſolids, thin fluids, and languid circulation, are the conſequences.

CHAP. XXVII.

Of Animal Food in hot Climates.

A DIET entirely animal, between the tropics, is productive of the oppoſite effects from that of a vegetable one. The heat and ſtate of the atmoſphere co-operate to promote and quicken the diſſolution of ſuch food, which, by its abundant nouriſhment, and ſpeedy animalization, counteracts the relaxing tendency of the climate, and gives ſtrength to the whole frame. Such a condition

condition of body is certainly the moſt deſirable, were it not the moſt dangerous; under ſuch circumſtances of food, the whole body is in a high animalized ſtate, and conſequently, in ſuch climates, under a ſtrong tendency to putrefaction. When obſtructions happen, which prevent the excretions in their due proportions, the body ſoon acquires, from its animalized condition, a putreſcent tendency that is ſpeedily increaſed by the heat, and the impregnated ſtate of the atmoſphere; which, as we have already ſhewn, renders it unable to abſorb a due proportion of phlogiſton from the lungs.

CHAP. XXVIII.

Of Animal Food in temperate and cold Climates.

IF a body is ſupported entirely by animal food in temperate climates, it will produce the ſame effect as in the warm ones, but

but not in ſo ſhort a time, as neither the impregnation nor temperature of the atmoſphere are fitted to favour putrefaction; and although the cold co-operates with the food in giving denſity to the fluids, by ſtrengthening the ſolids, yet the ſame cold and food quicken motion, and the firſt unites with the depurated ſtate of the atmoſphere to prevent the progreſs of putrefaction, by enabling the lungs to make a more abundant diſcharge of the phlogiſtic principle. When we remove further north, a diet of the ſame kind is ſtill more counteracted by the unimpregnated ſtate of the atmoſphere, and the powers of cold as an antiſeptic; and in conſequence, the effect of a continued animal diet is longer reſiſted in the latitude of 60 than 40. When we go ſtill further north, and take a view of the inhabitants of Lapland, Groenland, and Nova Zembla, whoſe food is entirely animal, and in the two laſt places

fiſh only, we ſhall be ſenſible of the effects of a depurated atmoſphere, in counteracting the tendency of ſuch food, by promoting a copious diſcharge of putreſcent or phlogiſticated matter from the lungs, on which the accumulation takes place, from an almoſt total want of perſpiration.

Theſe are ſtrong and undoubted proofs, that a denſe dephlogiſticated air may ſo promote the diſcharge by the lungs, as to make it equivalent to the deficiency by perſpiration.

We have already mentioned, that Dr. Keill and Dr. Hales determined the diſcharge by the lungs in this country to be ſix ounces out of thirty-one, which is rather leſs than one fifth part; if therefore we take this as a medium, we may ſuppoſe in the hot latitudes, that this diſcharge by the lungs is to that by the ſkin, as a ſeventh

part

part of the whole only; whereas at Groenland it may be a third part of the whole, or perhaps at Zembla one half of the whole. This ſuppoſes the ſame body under the ſame circumſtances of food in all the three places. There is every reaſon to ſuppoſe theſe variations very great, as Dr. Prieſtley hath ſhewn, that pure air is five times leſs phlogiſticated than atmoſpherical air in this climate; and we know that common air can admit a much greater charge, as well as greater degree of depuration.

From what has been ſaid above, it is evident that every expiration at Groenland or Nova Zembla carries off a much greater quantity of putrid effluvium or phlogiſton, than an expiration between the tropics is capable of doing, where the air is not only dilated by the heat, but greatly impregnated.

The inhabitants of theſe northern climates are generally afflicted with ſcurvy, and it is obſerved that the natives have the moſt diſagreeable fœtid breaths *; and that their urine, when kept, ſmells moſt intolerably †.

CHAP. XXIX.

Of Diſeaſes peculiar to hot Climates.

RELAXATION of body may be conſidered as a certain degree of putreſcent tendency, which tendency ſeems the cauſe of almoſt all the endemic diſeaſes of the torrid zone. We have already particulariſed that ſpecies of putreſcency which ariſes from debility, and which takes place in warm climates from a crude vegetable diet.

* Harris's Collection of Voyages. Journals of the North Sea Company of Copenhagen.

† Same Book. Mr. John Egede, a Daniſh Miſſioner, his Account of the Inhabitants of Groenland.

Scorbutic habits, rather than ſcurvies, are alſo frequent from a too much animalized ſtate of the body, and an impregnated atmoſphere. Diarrhœas and dyſenteries, from crude vegetable food and relaxation, are alſo very common. Putrid fevers from ſuppreſſed perſpiration, and an impregnated atmoſphere *, are exceedingly general; by which the matter that ſhould be diſcharged from the ſkin and lungs is retained, and theſe operate rapidly from the circumſtances of climate.

Nervous diſeaſes are alſo the effect of relaxation, conſequently frequent in warm countries. The diſagreeable, and often highly putrid ſmell of the diſcharge from bliſters in this diſeaſe, proves the putreſcent tendency of the humours.

* See Chap. XXI. of this Part.

The tetanus, or locked jaw, from ſlight wounds, is moſt common between the tropics, and ariſes from an exceeding irritable ſtate of the nerves *. Nothing can more ſtrongly prove this, than obſerving what people are moſt ſubject to it. There is ſcarce an inſtance of a white man falling a ſacrifice to this diſeaſe, but ſuch as have been reduced to a low and very relaxed ſtate by long ſickneſs, or exceſſive debauchery. Even negro domeſtics are very rarely attacked with it; while it is common among the labourers, and almoſt without exception fatal. The reaſons of this obviouſly ariſe from their way of living, which we have already mentioned in Chap. XXIII, XXIV, and XXV.

* That atony and ſpaſm can ſubſiſt at the ſame time in the ſame veſſels, Doctor Cullen in his Firſt Lines conſiders as undoubted.

CHAP.

CHAP. XXX.

Diſeaſes peculiar to very cold Climates.

THE endemic diſeaſes of the frigid zone ariſe from an over-tenſe fibre in conſequence of too great a degree of cold. A general tendency to putrefaction, from a too high animalized ſtate of the body, reſulting from food and want of perſpiration, is alſo moſt common, notwithſtanding the dephlogiſticated ſtate of the air which the inhabitants breathe. What would be the effect of a continued vegetable diet, to an inhabitant of Nova Zembla, is difficult to ſay; but it ſeems probable that a putreſcent tendency may there be abſolutely neceſſary to ſupport animal heat and motion.

This appears in a ſtronger point of view when we conſider, that by Dr. Crawford's

theory of animal heat it is proved, that bodies loſe their ſenſible heat more quickly in proportion as the atmoſphere they are in is colder. Hence in very cold climates a larger proportion of heat muſt be precipitated from the air taken into the lungs, to make up for the continual expence of heat from the ſurface of the body: but the quantity of abſolute or latent heat in atmoſpherical air, depends on the purity of that air; and to precipitate and render that heat ſenſible, depends on the quantity of phlogiſton furniſhed to make the decompoſition in the lungs. Hence a putreſcent tendency of body, which admits a copious evolution of the phlogiſtic principle, ſeems neceſſary to procure a ſufficient decompoſition of heat from the atmoſpherical air in the lungs, to keep up the temperature of the body. Facts verify this doctrine; for the air of all climates is found more dephlogiſticated in proportion as they become colder; while the atmoſphere of the tropical latitudes, by being more phlogiſti-

cated,

cated, contains leſs heat, and conſequently is leſs capable of increaſing the heat of the blood in the lungs. A great precipitation of heat from atmoſpherical air is leſs neceſſary in thoſe climates, as the expence of ſenſible heat from the ſurface of the body, is infinitely leſs than in northern regions. It therefore ſeems probable, that the ſupply of heat which takes place in the lungs, is regulated by the loſs of heat from the ſurface of the body, as the atmoſpheres of different countries are phlogiſticated in proportion to the warmth of theſe countries, and according to the degree of that warmth do they abſorb the heat more or leſs rapidly from the ſurface of the body; hence, in hot climates, where the latent heat of the atmoſphere is ſmall, the decompoſition in the lungs will be moderate, and the loſs of heat from the ſurface of the body be diminiſhed in the ſame proportion. In this way we ſuppoſe the univerſal equality of human heat in all climates may be accounted for.

Thus

Thus an habitual putreſcent ſtate of the human body ſeems neceſſary in very cold climates, as it affords the natural and moſt effectual means of correcting their influence, and ſupporting the proper degree of heat neceſſary to life.

CHAP. XXXI.

Of the Diſeaſes of the Middle or Temperate Climates.

OVER this diſtrict of the globe, which we ſuppoſe to extend from the 30th to the 65th degree of latitude on each hemiſphere of the earth, there is, generally ſpeaking, ſcarce any diſeaſe, or claſs of diſeaſes, which can be called endemics, as in no part do we find thoſe cauſes exiſting with ſufficient influence, which determine the diſeaſes of the torrid and frigid zones*; but in

* Baron de Monteſquieu makes an obſervation ſimilar to this, relative to the genius of the nations of the middle climates :

' Dans les pays tempérés vous verrez des peuples incon-
' ſtans

in conſequence of this want of force to give a general character, we find, in the temperate climates, the diſeaſes of both the hot and cold latitudes mixed together under a vaſt variety of forms, multiplied by innumerable cauſes which depend on ſituations, ſeaſons, population, woods, moraſſes, and the ſtate of cultivation. From theſe and other ſimilar natural cauſes, ariſe the variety of diſeaſes which are found in the temperate climates, while thoſe of the torrid and frigid zones are few, and generally uncomplicated.

CHAP. XXXII.

Of being habituated to Climate.

WHEN Europeans arrive in the hot latitudes, their bodies are not for ſome time ſufficiently relaxed to diſcharge their perſpiration freely: hence ariſes what

' ſtans dans leurs manieres, dans leurs vices mêmes et dans ' leurs vertus; le climat n'y a pas une qualité aſſez déter- ' minée pour les fixer eux-mêmes.'

De l'Eſprit des Loix, Tome ii. Chap. 11.

is

is called the ſeaſoning, which is an inflammatory fever.

The great evacuation the patients ſuffer in the courſe of their cure, relaxes the veſſels, and perſpiration becomes thereafter free and eaſy; this is the change or degree of relaxation meant by ſeaſoning, or being habituated to the hot climates.

Similar effects will follow to perſons going from hot or temperate climates to Groenland or Nova Zembla. The perſpiration to which the body has been accuſtomed is prevented by the cold, and the force of circulation hath not yet dilated the veſſels of the lungs, to let them diſcharge ſo plentifully as thoſe of the natives, the rigidity of whoſe ſolids forces a ſtrong circulation, by which a copious diſcharge is made. Strangers are therefore more ſubject to the ſcurvy than the natives,

and

and are more ſo the firſt winter than afterwards, when they become ſeaſoned, or habituated to the climate by the dilatation, of the veſſels of the lungs; and theſe veſſels are kept in that ſtate, or rather ſtill dilating, by the quantities they are forced to diſcharge.

CHAP. XXXIII.

Of the Lunar Influence on Animal Bodies between the Tropics.

WE have in the Firſt Part endeavoured to point out the influence of the moon in promoting the circulation of the vegetable kingdom, by her attraction, elevating and diminiſhing the perpendicular preſſure of the atmoſphere. We ſhall now take notice of her influence on diſeaſed and weak habits in the tropical climates.

In

In the equatorial latitudes, people of delicate conſtitutions, either from nature or diſeaſe, are exceedingly ſenſible of the lunar influence at change and full; and thoſe who are in any degree afflicted with that ſpecies of madneſs called lunacy, have their fits more violent than in northern climates*. If debilitated perſons are attacked with intermittent fevers, they find it very difficult to avoid a relapſe or return of the fever at new and full moon. This fact is ſo well known in thoſe climates, that ſuch people generally take a certain quantity of bark each day, for ſeveral days before each change and full; which commonly pre-

* Mr. Griffith Hughes, in his Natural Hiſtory of Barbadoes, makes this obſervation: 'Nor is it leſs improper (ſays 'he, meaning the climate) to perſons who labour under any 'degree of phrenſy or madneſs, whoſe periodical fits, 'at the full and change of the moon, return here with 'greater violence than in a cold climate.'

Page 11. the Notes.

vents

vents a return of the diſeaſe, unleſs the patient is exceedingly weak, and unable to contribute to the tonic powers of the bark, by riding or other gentle exerciſe.

Theſe effects of the moon's poſition ſeem to reſult from the diminiſhed weight of the atmoſphere, by her increaſed attraction when in the particular ſituations of full and change; by which a part of the external preſſure is gently removed, and the body allowed to dilate itſelf; a debility of the whole ſyſtem is the natural conſequence of ſuch dilatation, and to correct this effect, the powers of the bark as a tonic are generally found ſufficient.

The action of the bark, at this time, hath been by many (particularly the French practitioners) attributed to its antiſeptic qualities, from an idea that thoſe returns

are occaſioned by the atmoſphere being at theſe times remarkably impregnated with putrid exhalations, produced by the power of the moon in promoting putrefaction.

Whatever effect this might be ſuppoſed to have at the full, it can have none at the change of the moon, as the contact of the lunar rays only ſeems to produce this effect, and the relapſes above mentioned are as common at the change as at the full*.

The cold bath is generally found as effectual as bark in preventing the returns of fever at new and full moon, from which we ſuppoſe that any tonic of equal power would produce the ſame effect.

* There are inſtances of particular people, who from ſome delicacy of conſtitution have moſt violent head-achs if they ſtand a quarter of an hour uncovered and expoſed to the full moon.

CHAP. XXXIV.

Of the Scurvy.

THIS diſeaſe may be deemed a general tendency to putrefaction, from a want of a ſufficient proportion of the vegetable antiſeptic acid, or a ſuperabundant alcaleſcency, which is in fact the ſame thing. This deficiency may ariſe from both the cauſes we have mentioned in a former chapter, viz. either an overabundant quantity of animal food, or a ſuppreſſion of the proper diſcharges of the body, by which the putreſcent matter is retained, and accumulates.

Although theſe cauſes are evidently different, yet they produce the ſame diſeaſe, and their effects are the ſame, when in an

equal degree. The tropical ſcurvies are different from thoſe of the north in degree only; yet we ſhall conſider them ſeparately, that we may be more eaſily underſtood.

CHAP. XXXV.

Of the Scorbutic Tendency of warm Climates.

IT is a fact well eſtabliſhed, that ſummer fruits and green aceſcent vegetables are ſure remedies in this diſeaſe, provided the proper diſcharges from the body are free and regular; of all which, perſpiration by the ſkin and lungs is of the greateſt conſequence. Where theſe are copious, the ſcurvy can never riſe to a great height; and from this cauſe alone, the diſeaſe in the tropical latitudes ſeldom runs beyond what may be called a ſcorbutic tendency, rather than a confirmed ſcurvy.

In

In theſe latitudes the diſcharge by the lungs is, from the impregnated ſtate of the atmoſphere, more moderate than in colder climates; and did not the abundant perſpiration by the ſkin make up for this defect, ſcurvies would there rage with their greateſt violence. From this effect of perſpiration, we may obſerve of what conſequence it is, either in preventing this diſeaſe or promoting its cure. The aceſcent fruits and other vegetables, which are to be found every where in theſe climates, afford the moſt effectual remedies, and the particular propenſities of the diſeaſed abundantly point out to them their utility. From the frequency of theſe remedies, and the free perſpiration in thoſe climates, one might be led to ſuppoſe that even a ſcorbutic tendency would rarely happen; but the caſe is far otherwiſe.

The inhabitants in eaſy circumſtances are ſeldom troubled with theſe complaints,

unleſs they live much on fleſh and fiſh, and take little exerciſe to promote perſpiration; yet from theſe cauſes, among even them, we have ſeen this tendency ſo great as to give putrid gums, and ſores on the face, legs, and hands, together with a rough dry ſkin, all of which were removed by a change of diet, exerciſe, and free perſpiration.

Thoſe who are the moſt afflicted with this diſeaſe in hot climates, are tradeſmen, low overſeers, and ſailors, who from their employments are expoſed to the moiſt damp air of the evenings and nights, which in low and wet inland ſituations greatly obſtruct the perſpiration, particularly in the rainy ſeaſon; and the ſame damp air being ill fitted to promote the diſcharge by the lungs, the retained putreſcent matter accumulates, and ſoon gives this general tendency to the body. To theſe ſources of this diſeaſe we may add the ſalt beef, which

which is almoſt their conſtant food. Theſe united cauſes, notwithſtanding the vegetables of the climate, are often found to induce a conſiderable degree of ſcurvy. Old wounds break out, and new ſcratches ſoon become ulcers, which diſcharge abundantly. When this is the caſe, thoſe drains retard the progreſs of the diſeaſe, by preventing an accumulation of the putreſcent matter, though they exhauſt the body by their continued diſcharge.

We have known ſores of this kind exiſting for ten or twelve years; during which time the perſons enjoyed good health otherwiſe, and we have been told of many of much longer ſtanding.

When theſe ſores diſcharge plentifully, the gums, which are generally affected, get well, and the appearances of ſcurvy go off; but a ſtoppage of them by violent ſtiptics

(which we have known done) often proves fatal, unleſs the general diatheſis of the body is altered by a long continuance of an antiſeptic regimen, and change of ſituation, to one where the patient may breathe a more dry air, and perſpiration be encouraged to flow moſt freely. Under theſe circumſtances they often cure of themſelves, with little or no dreſſing. Thoſe ulcers become a kind of new outlet, or artificial drain, by which the putreſcent and phlogiſticated matter of the body is diſcharged, when the ſtate of the atmoſphere and interrupted perſpiration are unable to free it ſufficiently faſt to prevent an accumulation. A ſudden ſtoppage of theſe diſcharges often affects the breaſt, and conſumptions ſometimes follow; but if large ulcers, which diſcharge plentifully, are injudiciouſly ſtopped, the conſequence is frequently a putrid fever, with all the ſymptoms of this diſeaſe peculiar to hot climates.

CHAP.

CHAP. XXXVI.

Of the Scurvy of the North.

FROM the foregoing chapters, it is obvious that obſtructed perſpiration will bring on the ſcurvy, let it proceed from whatever cauſe it may. In the temperate climates this obſtruction generally ariſes from moiſture, which not only prevents perſpiration by the ſkin, but clogs the air, and renders it unfit to carry off a due proportion of putreſcent matter from the lungs. As a proof of this, we may have recourſe to Dr. Lind's treatiſe on the ſcurvy; he has given many inſtances, where a moiſt atmoſphere, conjoined with a very moderate degree of cold either at ſea or land, have been productive of ſcurvy. And why ſeamen in long voyages are more

ſubject to it than men at land, the ſame author makes clearly to ariſe from their being more expoſed to theſe cauſes, together with a greater want of proper vegetable correctors.

From what that gentleman hath ſaid, it is evident that ſea air does not diſpoſe the body to a ſcorbutic tendency; and we are for the following reaſons of opinion, that it rather counteracts a putrid diatheſis.

Agitation with water will depurate phlogiſticated air; and the more any air is freed from its phlogiſton, the greater load it will carry off from the lungs, and the longer it will ſupport animal life*.

We

* Dr. Prieſtley ſays, 'Since, however, water in theſe Experiments muſt have imbibed and retained a certain proportion of the noxious effluvia, before they could be tranſmitted to the external air, I do not think it improbable but that the agitation of the ſea and large lakes may be

We are therefore led to ſuppoſe, that the ſea air is more dephlogiſticated than that of the land. This opinion is much confirmed by an obſervation made by moſt writers on the ſcurvy; which is, that this diſeaſe rages moſt in narrow ſeas, and channel cruiſes, and in ſhips ſtationed on coaſts. Some cauſe muſt produce this difference, and it ſeems no other than the very moiſt and impregnated ſtate of the air in ſuch ſituations, both of which are the effects of vicinity to the land.

From this view of the cauſes of ſcurvy, people on ſhore are protected from it more effectually than thoſe at ſea, by the conveniences of life and vegetable food. Were theſe wanting, and the perſonal expoſure

' be of ſome uſe for the purification of the atmoſphere; and ' the putrid matter contained in water may be imbibed by ' aquatic plants, or be depoſited in ſome other manner.'

Prieſtley on Air, vol. i. page 98.

equally

equally great and frequent, there is little doubt but it would be as violent on land as at ſea.

When we remove further north, where the air is more clear and dry, the cold increaſes in proportion, and effectually ſtops the pores, and prevents a diſcharge of the putreſcent matter by the ſkin; but in theſe places the purity and denſity of the atmoſphere enable the lungs to make moſt copious diſcharges; and by this evacuation, together with the antiſeptic powers of the cold, notwithſtanding the high animalized diet of the inhabitants, the ſcurvy ſeldom runs to ſuch heights among the natives, as it often does on board of King's ſhips in more temperate climates, where the obſtructions ariſe from moiſture *. In both caſes, whether

* Sir John Pringle, by his experiments on common ſalt, makes it to be in ſmall quantities rather a ſeptic, than otherwiſe, when taken into the body, or in warm mixtures when out

whether the perſpiration is ſtopped by moiſture or cold, or both, the effects are the ſame, unleſs relieved through the lungs; and this diſcharge, as we have already obſerved, varies in quantity according to climate.

out of it. This ſeems to account for ſalt proviſions giving a ſeptic tendency more readily than the ſame meats when eaten freſh. It alſo affords an explanation of its effects when given to herbacious animals. If they are emaciated and unable to digeſt their food, a mixture of ſalt (which they are exceedingly fond of, when troubled with indigeſtion) gives them a freſh appetite, by acting as a ſtimulus in the firſt place, while in the ſecond place, by promoting the diſſolution of their food, the extraction of the chyle muſt be facilitated.

It hath been ſuggeſted by Dr. Cullen, that this effect of common ſalt probably ariſes from ſome impurities of the abſorbent kind mixed with it, which is the caſe unleſs particular pains be taken to purify it. But even ſhould theſe effects ariſe from ſuch impurities, as they are general in common ſalt, the uſe of it will ſtill be productive of thoſe conſequences, in both carnivorous and herbacious animals.

CHAP.

CHAP. XXXVII.

Of a Diet to prevent the Scurvy at Sea.

FROM the foregoing obſervations and theories, a conſtant and regular ſupply of vegetable antiſeptics, which produce proper acids by their fermentations, are not only neceſſary; but a due evacuation by perſpiration muſt be kept up, to prevent an accumulation of the putrid matter generated in the body. The methods in practice at ſea are much more directed to anſwer the firſt indication of cure than the ſecond; but experience makes it evident, that without accompliſhing both in a certain degree, it is impoſſible to prevent the ſcurvy. Dr. Lind ſays, that ſweat is an evacuation from which ſcorbutic patients find the greateſt benefit, and he therefore adviſes antimonials, aromatics, and warm baths.

Dr.

Dr. M'Bride adviſes warm clothing; and could his advice be followed in this particular, it would doubtleſs produce the beſt effects. The wort recommended by this gentleman had a favourable appearance, but on trial hath not been found to anſwer the end propoſed*. It is calculated to anſwer the firſt indication of cure, but will not accompliſh the ſecond, which is as neceſſary as the firſt, and muſt be at leaſt equally attended to, or every attempt will prove unſucceſsful. A kind of beer recommended by Dr. Sylveſter, compoſed of crude tartar, juniper berries, orange peel, ginger, cloves, and ſugar, ſeems to have been much more effectual than the wort†.

It

* Theſe trials were made by Mr. John Clark, Surgeon to the Talbot Indiaman.—See his Obſervations.

† Trials with this alſo made by the ſame gentleman, Mr. Clark. See his Obſervations.

Mr. Patten, Surgeon to the Reſolution, commanded by our great circumnavigator Capt. Cook, has a more favourable

It hath generally been found, that the alcaleſcent and aromatic plants contribute exceedingly to the cure of the ſcurvy; it is evident that this effect cannot ariſe from antiſeptic qualities, as thoſe plants yield exceeding little of the vinous or acetous principle, and many of them ſo very little as ſcarce to be diſcovered by any proceſs whatever. (See Chap. III. and VIII. of this Part) Theſe effects ſeem therefore to reſult from their penetrating, warming, diuretic, and ſudorific qualities, by which they promote a very free perſpiration from the ſurface of the body, and a copious diſcharge by urine.

able opinion of the wort, as per extract from his Journal (See Sir John Pringle's Diſcourſe on preſerving the Health of Mariners, delivered at the Royal Society, Nov. 30, 1776). The great attention paid by Capt. Cook to his people, their warm clothing, and being only one third of their time on duty inſtead of one half, which is common; were moſt powerful aſſiſtants to the wort, by tending to keep up that perſpiration which ſeems ſo neceſſary to prevent the ſcurvy.

Theſe

Theſe evacuations carry off the putreſcent matter, which would otherwiſe accumulate; and in this way, we apprehend, they do ſervice in ſcurvies, and not as antiſeptics, from the volatile alcaline ſalt they contain.

Perſpiration in the warm climates is found to prevent ſcurvies, notwithſtanding an animal diet and high impregnated atmoſphere; and if our opinion is well founded relative to the action of the ſecond claſs, viz. the alcaleſcent and aromatic plants, we ſhall find that a due mixture of theſe vegetables with thoſe of the firſt claſs, will produce the end wiſhed for, as it ſeems natural to ſuppoſe, that a much leſs degree of perſpiration, procured by theſe means in a cold country, will prevent the ſcurvy, than what might be neceſſary in the hot latitudes, where the climate is ſo very favourable to putrefaction. The opinion of Dr. Lind favours this idea very much; and the

ſucceſs of Dr. Sylveſter's beer, in the experiments made by Mr. Clark, is alſo a preſumption in its favour. We are therefore led to ſuppoſe, that a large mixture of the alcaleſcent and aromatic plants, preſerved raw in vinegar or wine, and made a part of the daily food of ſeamen, would in a great meaſure keep up the neceſſary perſpiration, particularly if warm clothing is joined, and both are added to the preſervatives of the aceſcent kind now uſed. Large quantities of muſtard, horſe-radiſh, garlic, and ſhallottes, together with pounded ginger, may be ſteeped in any cheap white wine, and the daily allowance of this given inſtead of the rum now in uſe.

Muſtard ſhould be freely uſed, and an abundant ſupply of horſe-radiſh, garlic, and onions preſerved raw in vinegar, ſhould be eaten with all kinds of ſolid food.

Theſe

Theſe ingredients are ſimple, their preparations eaſy, and may with little expence be made at all times before a voyage begins, in ſufficient quantities to ſerve through the courſe of the longeſt, without loſing their qualities.

Thoſe preparations added to the food of ſeamen, and abundantly ſupplied where the ſituations are either cold, or damp, or both, together with ſpruce beer, with which may be fermented ſome ginger, and the chips or raſpings of guaiacum-wood, will make a moſt agreeable liquor for common drink, which we apprehend is well fitted to correct a putreſcent tendency by its action to both, as an antiſeptic and ſudorific.

Theſe ſimples uſed in the extent propoſed, muſt, we imagine, anſwer both indications of cure, and alſo ſuperſede the

uſe of ſpirituous liquors, ſo generally thought neceſſary by ſeamen in cold wet weather.

CHAP. XXXVIII.

Of Phthiſis Pulmonalis, or Conſumption of the Lungs, as conſequential to Climate.

THIS diſeaſe is evidently a putrid one, though more properly belonging to the temperate regions, than either to the torrid or frigid zones. It generally originates from inflammatory diſorders, ſuch as coughs, peripneumonies, &c.; and although a degree of inflammation may accompany the phthiſis through all its ſtages, yet it is here to be conſidered as a chronic diſeaſe of the putrid kind, as the degrees of inflammation which attend it in its formed ſtate, are rather conſequences than cauſes of the malady. Dr. Alexander ſays, that a

piece

piece of meat putrifies ſooner, that has been breathed upon by a perſon with diſeaſed lungs, and a bad breath, than another of the ſame weight that has been breathed upon for the ſame time by a ſound perſon *. This is a very full proof that the diſeaſe is not only putrid, but that a part of the putrid matter is diſcharged with the air by expiration, which acts as a ferment on the meat with which it comes in contact.

In the warm climates, a ſeptic tendency of the body makes its appearance under the different forms of putrid fevers, diarrhœas, or ſcorbutic habits. In the far northern latitudes, the diſeaſes of the lungs are the conſequence of ſcurvy; there, during the winter ſeaſon, from the almoſt total want of perſpiration, an over-quantity of phlogiſticated matter is thrown on the lungs,

* Alexander's Enquiry, page 48.

which they are not able to diſcharge ſo quickly (notwithſtanding the purity and denſity of a northern atmoſphere), as to be unaffected by it. In the torrid zone, an accumulation of putreſcent matter is rapidly increaſed by the heat, and operates moſt ſpeedily, unleſs diſcharged by ulcers, profuſe ſweats, or ſudden diarrhœas.

In the middle climates, the colds are not ſufficiently great to ſtop the perſpiration ſo effectually as to produce ſcurvies, while by a diminution of it, an over-proportion of moiſture and phlogiſticated matter is caſt on the lungs, which the more impregnated atmoſphere of the middle climates is leſs able to carry off, than the denſe depurated air of the frigid zone; and when perſpiration is deficient here, the preſſure for diſcharge by the lungs is increaſed, which brings on inflammation, hæmoptiſis, &c.

From

From this concentration of the putreſcent or phlogiſticated matter of the body towards the lungs, as the moſt natural outlet when perſpiration is diminiſhed, ariſes, we apprehend, that clear and pellucid ſkin, ſo peculiar to thoſe who are conſumptively inclined, and even continues to the laſt in thoſe whoſe diſeaſe is ſolely confined to the lungs. When the putreſcent tendency diffuſes itſelf through the whole body, it is then a certain degree of ſcurvy; and in ſuch caſes the ſkin becomes dark and tawny, which is the conſtant attendant of a general putreſcency, as will be more fully mentioned in Part the Third.

CHAP. XXXIX.

Places moſt productive of Conſumptions.

LOW, damp ſituations prevent a free diſcharge by the ſkin, and if the flats are extenſive and very much incloſed, the

atmoſphere becomes more impregnated with moiſture, which not only obſtructs perſpiration, but renders the air leſs able to free the lungs by expiration. For we muſt here obſerve, that air is capable of a certain ſaturation with moiſture as well as phlogiſton; and when the degree of its impregnation with humidity is conſiderable, the neceſſary diſcharge of moiſture from the lungs is impeded in proportion, and the diſcharge of this vapour is as neceſſary to free reſpiration, as that of the phlogiſtic principle. It is in this way, we apprehend, that air, by a load of moiſture, is unfitted for free reſpiration *, and will even extinguiſh a candle †.

There are inſtances of particular places and towns, the inhabitants of which, from

* Air, impregnated with the vapour of pure water, threw a bird into great anxiety. See Dictionary of Chemiſtry on Gaſes, page 16.

† See Prieſtley's Miſcellaneous Obſervations, vol. i. page 159.

being

being free of theſe diſeaſes, have become, in the courſe of thirty or forty years, exceedingly ſubject to them. The increaſe of ſuch towns, the greater quantity of animal food eaten, and the leſs exerciſe taken, together with the ſurrounding country becoming much incloſed, particularly if the climate is moiſt, and the ſoil abounding with clay (which retains the rain on its ſurface, by preventing filtration into the earth); all theſe cauſes tend to promote putrefaction in living animal bodies, by impregnating the air with humidity, which renders it unable to give relief by the lungs, when a more than ordinary diſcharge is required in conſequence of diminiſhed perſpiration, which is always an attendant of a humid atmoſphere. While the body is in good health, and in a proper climate, a diminution in the quantity of any one excretion is made up by the increaſe of others, on which nature flings the load to

be diſcharged ; but when climate (on which depends the ſtate of the atmoſphere) is unable to aſſiſt, or counteracts the efforts of nature, by preventing that copious diſcharge which is neceſſary, by one excretion, to make up for the deficiency of another, diſeaſe muſt be the conſequence, as in conſumptions.

This malady, then, before tubercles or ulcers are formed, ſeems not to be a general increaſed evolution of putreſcent matter, as in the ſcurvy, but the diſcharge of the natural quantity too copiouſly directed towards the lungs, by the diminution of perſpiration ; in conſequence of which obſtructions and inflammations come on, which are followed by the true phthiſis pulmonalis, or conſumption of the lungs *.

* This diſeaſe may be hereditary, we ſuppoſe, by a peculiar texture of ſkin, ill fitted to diſcharge perſpiration freely. It may alſo be ſo, from mal-conformation of the thorax.

Hippocrates

Hippocrates ſays, this diſeaſe happens principally from the age of eighteen to thirty-five; but there are not wanting inſtances of it, both before and after theſe periods, though from the vigour of that time of life, a phlogiſtic diatheſis is doubtleſs vaſtly more common and dangerous.

CHAP. XL.

Of the Cure of Conſumptions.

FROM what we have pointed out as the cauſe of this diſeaſe, the cure is to be accompliſhed by reſtoring a free perſpiration, and breathing a pure dephlogiſticated air, together with proper evacuations, and antiphlogiſtic food and medicine to diminiſh the putreſcent tendency as much as poſſible. Warm clothing, with gentle exerciſe, or riding on horſeback, joined

joined to a vegetable and milk diet, often produce the beſt effects; but when the diſeaſe does not yield to theſe means, a copious diſcharge by iſſues is often of the greateſt ſervice.

From the ſudden effect which old ulcers, injudiciouſly ſtopped by violent ſtyptic medicines, have on the lungs, it ſeems probable that artificial ones brought on the legs by cauſtics, or actual burning, and encouraged to flow moſt freely, would bring relief to the lungs, and through them, that phlogiſtic matter be evacuated, which the lungs are unable to diſcharge.

We have ſeen ulcers ſtopped, which ſoon affected the breaſt; but the diſcharge being again brought on, the lungs were relieved, and the patient remained in his former health.

When

When all theſe methods prove ineffectual, and the putrid matter can neither be corrected, nor diverted into another channel, a ſea-voyage to the ſouthward frequently proves a cure, if the diſeaſe was not too far advanced before this remedy is attempted. In going to the ſouthward, the pores of the body are opened, and the depurated ſtate of the ſea air enables the lungs to fling off the phlogiſton with which they are overcharged. Beſides the purification of ſea air, from paſſing along the ſurface of an extended ocean, it is alſo much impregnated with ſaline matter, which, together with its depuration, renders it ſo exceedingly unfavourable to vegetable, and ſo very ſalutary to animal life, particularly in caſes of a putreſcent tendency which affect the lungs. The exiſtence of this ſaline matter in ſea air is indubitably proved by the great difficulty there is to keep iron from ruſt, not only at ſea, but in every place

where the ſea air pervades, and in warm climates this is ſtill more obſervable. On ſhip-board, a cloth waſhed with freſh water, and dried, is perfectly taſteleſs when chewed; but if hung up expoſed to the wind, it acquires a ſtrong ſaline taſte; this experiment we have often made. Theſe ſaline particles muſt be antiſeptic, which being applied to the lungs with the very air itſelf, at every inſpiration, will counteract the progreſs of putrefaction, at the ſame time that a larger proportion of phlogiſticated matter is diſcharged by each expiration at ſea than at land, and thus ſea air acts beneficially in a double capacity.

It is a very general idea in this part of the world, that the climate of the torrid zone is favourable to conſumptive people; but experience proves the opinion not generally juſt, for not one in ten recover if they

they remain on land; as the too warm impregnated ſtate of the tropical atmoſphere, is exceedingly unfavourable to theſe complaints; but if the patient keeps very much at ſea, and has the benefit of both its air, and free perſpiration from the warmth, his chance, if ſupplied with proper food and medicine, and a roomy veſſel, in which he can get a little exerciſe, is the beſt he can have *.

The moſt favourable ſituations for the reſidence of perſons afflicted with theſe complaints, are near the ſea, in a dry and moderately warm climate, ſituated between the latitude of 36 to 45 degrees; in ſuch places, the air is at no time ſo much impregnated with the phlogiſtic principle, as between

* We have known an inſtance, where a perſon ſoon got well at ſea, but by reſiding at land, the complaints returned, and on going to ſea, were again removed.

the

the tropics, though nearly as much charged with ſaline vapour by contact with the ſurface of the ſea, while the warm dry weather in ſuch a climate is ſufficient to keep up a proper diſcharge from the ſurface of the body.

If the air of a chamber could, by artificial means, be ſo mixed with pure dephlogiſticated air, as to render it greatly better than common air; perhaps (by keeping it in a ſtate of depuration comparatively with that of dephlogiſticated air, as one to three, or one to two, inſtead of the common ſtate of atmoſpherical air, which is one to five), we ſhould be able effectually to diſcharge by the lungs the phlogiſtic accumulation, while the general ſtate of the body might be corrected by proper antiphlogiſtic and antiſeptic methods, ſo as to prevent, if kept in that condition, the riſk of accumulation

lation from the future uſe of common atmoſpherical air *.

CHAP. XLI.

Of the Small Pox.

THE ſucceſs of the new and cool method of treating this diſeaſe, evidently proves it of the putrid kind. When the patients are of a full habit, and have lived freely, this diſeaſe in all its ſtages is moſt violent, as ſuch a ſtate of the body diſpoſes it exceedingly to putrefaction; conſequently a foreign matter introduced into the blood, which of itſelf is ſufficient to diſpoſe the moſt mild fluids to putrefaction, muſt operate with increaſed violence on ſuch as have already too great a tendency that way.

* The ingenious Dr. Prieſtley was not only the diſcoverer of dephlogiſticated air, but gave the firſt hint with reſpect to its utility in reſpiration, vol. iii. p. 85.

From

From this reaſoning we may eaſily ſee the great advantages which attend a proper preparation by food and medicine; all animal matter muſt be avoided, and ſpirituous liquors of every kind; in ſhort, the nearer the body is brought to the ſtate of ſimple animal ſubſtance, the leſs dangerous will this diſeaſe be, as it will more ſtrongly counteract the tendency of the variolous matter, than when in a more animalized ſtate; therefore a vegetable and milk diet for a certain period, according to the habit of the patient, with gentle ſaline cathartics, will be a ſufficient preparation, if continued a due time before inoculation is performed.

In the Weſt Indies, this diſeaſe is more favourable among the negroes than the white inhabitants, and for the reaſons we mentioned in a former chapter, viz. their way of living, which is almoſt wholly on vegetables. We have ſeen ſeveral in-

ſtances where white people and negroes were inoculated with the ſame matter, without any previous preparation to either; and in all ſuch caſes the white patients ſuffered much more than the black ones.

CHAP. XLII.

The Effect of Air in the Small Pox.

WHENEVER a putreſcent tendency is prevalent in the body, the lungs are charged and oppreſſed to get quit of the load of phlogiſtic matter; but the facility of this diſcharge, as hath been mentioned, depends on the ſtate of the air the patient breathes. The plague, for example, originates in warm and populous countries, where the atmoſphere muſt be much impregnated. It is a well-known fact, that froſt always gives a ſudden check to the progreſs of this diſeaſe, which not only re-

reſults from cold being unfavourable to putrefaction, but alſo from the increaſed denſity and depuration of the atmoſphere, by which, the diſcharge of the putreſcent effluvium from the body through the lungs is greatly increaſed.

The ſmall pox, as well as other putrid diſeaſes, is much regulated by the ſtate of the atmoſphere; a patient who is reſtleſs, pants, and is diſtreſſed to the laſt degree in a warm room, gets immediate relief upon being carried to a window, or out of doors, in a froſty day. The warm loaded air of a chamber which hath been reſpired, and conſequently phlogiſticated, is unable to give relief to the lungs when oppreſſed with an over proportion of phlogiſton; whereas the cold denſe and depurated air of the fields carries off a great charge by every expiration, and ſoon frees the lungs from the accumulated putreſcent or phlogiſticated matter.

It ſeems exceedingly probable, that by a due preparation before inoculation, ſo that the body may be the leaſt poſſible diſpoſed to putrefaction, together with gentle antiphlogiſtic purgatives after the operation, and a continued pure air, kept cool and frequently changed (particularly if its quality is improved by a mixture of dephlogiſticated air) the diſeaſe may be made to paſs off entirely by the lungs and inteſtines, without the eruption of a ſingle puſtule.

Although the air a patient reſpires cannot be too cold in this country, yet if the body is kept much cooler than common, the perſpiration may be ſtopped, and a fever brought on totally unconnected with the ſmall pox; this is to be guarded againſt by wearing the ordinary clothing both day and night, unleſs a ſenſe of heat make ſome diminution neceſſary; for the great effect of cool air is in the reſpiration, and

not from its external contact with the body; though ſomething may alſo reſult from that, by making the diſcharge to the ſurface more difficult, and conſequently ſending off more of the variolous matter by the lungs.

Fires in the bed-rooms of patients in the ſmall pox are improper, as they heat and rarify the air, which renders it leſs uſeful for reſpiration; hence this diſeaſe is more fatal in hot climates, where the air is always more dilated and phlogiſticated than in cold ones; and it is even obſerved in the inland and leeward hot ſituations of the Sugar Iſlands, to be more ſevere and mortal, than on the ſea-coaſt towards the wind, where the atmoſphere is kept more cool and depurated by the ſea air.

Baron Dimſdale ſays, 'Inſtead of ſup-'poſing the fever in the ſmall pox to be the 'inſtrument employed by nature to ſub-'due

'due and expel the variolous poiſon, we 'ſhould rather conſider it as her greateſt 'enemy, which if not vigorouſly reſtrained, 'is apt to produce much danger; and that 'all ſuch means ſhould be uſed, as are moſt 'likely to controul its violence, and extin-'guiſh the too great fervour of the blood.'

A fever ſeems to be an exertion of the ſyſtem, produced by ſome irritating matter retained in the body; therefore to avoid the fever, the expulſion of this matter is neceſſary by that channel of evacuation which nature ſeems to point out. In the ſmall pox this is moſt eaſily accompliſhed through the lungs, by the reſpiration of a cool depurated air, and when the cauſe is thus evacuated, the fever will ceaſe *.

* Dr. Ingen-houſz has in his preface mentioned that his friend, the Abbe Fontana, had found an eaſy cheap method of procuring to a ſick perſon the benefit of breathing any quantity of dephlogiſticated air. For the method, ſee Dr. Ingen-houſz's Preface.

PART III.

Of the Appearance, and Characters of Nations, reſulting from Climate.

CHAP. I.

The Object of this Third Part.

IN the Firſt Part we have attempted to ſhew, that the ſtate of vegetation in every country is determined by its climate; in the Second, we have conſidered how the qualities of food, with the external influence of climate, do actually determine the condition of animal bodies; from which it ſeems natural to conclude, that the mind, by its intimate connection with the body,

will alſo be affected by its particular condition. The object, therefore, of the ſucceeding chapters, is to trace, and ſhew the actual influence of climate, in changing the powers of the mind, and to attempt the inveſtigation of thoſe particular cauſes, which produce theſe changes, and alſo to point out how the predominance of the ſame principle is productive of the ſame effects on the mind as well as on the body, in the extremes of heat and cold.

CHAP. II.

Of the different Opinions of the Cauſes which determine the Characters of Nations.

HELVETIUS, in his Eſſays on the Mind, treats the operation of phyſical cauſes, in producing the genius and characters of men, as groundleſs and chimerical,

merical. This gentleman refers all ſuch differences to moral cauſes; and to enforce the juſtneſs of his principles, he attempts to prove, that all mankind are, by the hand of nature, equally fitted for all things; and that the characters of individuals, as well as thoſe which are called national, reſult from government and education.

Mr. Hume, in his Eſſay on National Characters, takes the ſame ſide of the queſtion, and endeavours to ſhow, that moral cauſes are capable of forming different characters. This philoſopher candidly acknowledges, that there is reaſon to think, that all the nations who live beyond the polar circles, or between the tropics, are inferior to the reſt of the ſpecies, and are incapable of all the higher attainments of the human mind. This acknowledged difference he ſtill endeavours to bring within the ſphere of his principles, by ſuppoſing the poverty and miſery

miſery of the northern inhabitants, and the indolence of the ſouthern, from their few neceſſaries, may, perhaps, he ſays, account for this remarkable difference, without having recourſe to phyſical cauſes. A note annexed to the end of his Firſt Volume of Eſſays, marked with the letter M, refers to the above paragraph, and evidently ſhews that, notwithſtanding his willingneſs to attribute the differences among men to the influence of moral cauſes, he is obliged to admit of exceptions, and acknowledge that the negroes are naturally inferior to the inhabitants of the temperate zones.

In oppoſition to theſe authorities, we ſhall firſt mention Baron Monteſquieu; this celebrated author has founded his ſpirit of laws on the influence of climate, and hath, with great judgment, in many inſtances, ſhewn how far the natural and moral cauſes

cauſes may be made to aſſiſt or counteract each other.

Monſieur Du Bos has adopted the ſame ſentiments in his Critical Reflections on the Fine Arts. The ideas of this author are, perhaps, a little too far puſhed, and his reaſonings, in many places, ſomewhat too fine ſpun; but notwithſtanding this, there are, in many parts of his work, ſtrong and evident proofs of the real influence of climate, in forming genius and character.

Dr. Ferguſon, in his Eſſay on the Hiſtory of Civil Society, conſiders the temperate climates as the diſtrict in which the human ſpecies arrive at their greateſt perfection, and ſays, 'Under the extremes of heat and 'cold, the active rage of the human ſoul 'appears to be limited, and men are of in-'ferior importance, either as friends or as 'enemies. In the one extreme, they are 'dull

'dull and ſlow, moderate in their deſires, 'regular and pacific in their manner of 'life; in the other, they are feveriſh in 'their paſſions, weak in their judgments, 'and addicted by temperament to animal 'pleaſure; in both, the heart is mercenary, 'and makes important conceſſions for child-'iſh bribes; in both, the ſpirit is prepared 'for ſervitude; in the one, it is ſubdued by 'the fear of the future; in the other, it is 'not rouſed, even by its ſenſe of the preſent.'

This author further adds, in another part of the ſame ſection, 'it is not in the 'extremes alone, that theſe varieties of ge-'nius may be clearly diſtinguiſhed. Their 'continual change keeps pace with the va-'riations of climate with which we ſuppoſe 'them connected.'

Did we propoſe to draw any concluſions from authorities, numbers of others might be

be adduced; but as that is not the caſe, further than to ſhew, that a difference is acknowledged by both parties, with reſpect to the inhabitants of the extreme climates, and that the fact ſeems diſputed in the temperate ones only; we ſhall attempt ſhewing how the moral or phyſical cauſes may prevail at different periods, in the ſame climate, if ſituated within the temperate zones.

CHAP. III.

An Attempt to reconcile theſe different Opinions.

IT is, we apprehend, admitted by all, that the characters of the Aborigines of the torrid and frigid zones are ſimilar to each other, and different from thoſe of the temperate climates. This variety, in thoſe diſtricts of the globe, cannot be ſup-

poſed

poſed to ariſe from the influence of moral cauſes. Were they the ſources of difference, their neceſſary fluctuations muſt have produced, at various periods, nations, as well as individuals, poſſeſſing genius and character equal to thoſe who very frequently appear within the temperate regions; but as far as we can learn, hardly an inſtance of national greatneſs, and ſcarce a ſample of ſuperlative ability in individuals, in any line whatever, can be adduced to prove the poſſibility of their riſing much above the low uniform level they have always been at*.

This

* The famous Mahomet may be mentioned as an exception; he was born about the end of the ſixth century at Mecca, a town of Arabia Deſerta, ſituated within the 22d degree of north latitude. This man had undoubtedly talents far ſuperior to any of his countrymen, but the great ignorance of the Arabians, and the other nations adjoining, was the foundation of his ſucceſs; and although his mental powers appear conſpicuous among his countrymen and followers, yet it is much to be queſtioned, if he would not ſink very low, upon a juſt compariſon with Ignatius Loyola, or any other enterpriſing European genius who had to combat with men of penetration. In a country where natural cauſes

This continued ſameneſs in the extremes of climate, muſt ariſe from ſources powerful, conſtant, and equal; phyſical cauſes are therefore ſtrongly indicated, as no moral ones, independent of natural and local qualities, can be ſuppoſed ſufficiently powerful and permanent for the production of ſuch unvaried conſequences.

This reaſoning ſeems to prove, that phyſical cauſes produce the peculiar diſpoſitions of the extreme climates, and we ſhall endeavour to make it more evident hereafter by particularizing thoſe cauſes: but in the mean time let us conſider it as a fact eſtabliſhed in the extremes only. From this it ſeems reaſonable to ſuppoſe, that theſe natural cauſes will loſe their influence

cauſes operate ſo powerfully as to produce a very general ſameneſs of character, a ſmall variety in favour of an individual becomes moſt conſpicuous; but in countries leſs influenced by natural cauſes, genius often ſtarts above the ordinary level, and to become a very diſtinguiſhed character, an individual muſt riſe ſtill much ſuperior to thoſe who have riſen above the multitude.

by

by degrees as we recede from the torrid and frigid zones; and in conſequence of their diminution, the moral ones will gain ſtrength.

It is obvious from hiſtory, that moral cauſes may be made to ſubdue the phyſical powers in the temperate climates; but revolutions and external force often relax the attention of the legiſlature. Under ſuch circumſtances the phyſical influence muſt in time become prevalent, with greater or leſs rapidity, in proportion to the aſſiſtance or counter-action it meets with from the moral cauſes; hence we ſuppoſe that nations in the temperate regions poſſeſſing the ſame diſtrict of territory, at diſtant periods of time, may widely differ from each other, by the prevalence of moral or phyſical influence.

The ſuperiority of moral cauſes, we apprehend, never can take place in either the

torrid or frigid zones, as the power of climate is in them too ſtrong to be totally counteracted.

Man is an animal whoſe health muſt depend on the due execution of his bodily functions, which in him, as in others, are influenced by external cauſes. Theſe are infinitely varied by climate; and however great the power of education and government may be over the actions of men in the middle climates, they muſt be allowed to have exceeding little in forming the complexion, ſize, and general turn of body; yet the inhabitants of particular countries are not leſs diſtinguiſhable by theſe external marks, than by their mental endowments; can we then ſuppoſe, that mind will be unaffected by the changes which the body undergoes? Although theſe changes are ſmall among the nations of the temperate climates, when compared to thoſe

of the extremes, and may therefore be counteracted by moral cauſes, yet it appears highly probable, that without ſuch counteraction, a particular turn of mind would regularly accompany each particular ſtate of body.

From the above reflections it appears, that the doctrines of Helvetius and Mr. Hume may be in a great degree right, when applied to the temperate climates, and neither of theſe gentlemen ſeem to extend them further. Thoſe who hope to ſolve every appearance and hiſtorical fact by natural cauſes only, without allowing any degree of weight to the moral ones, ſeem as erroneous as others who wiſh to exclude all phyſical ſources of difference.

From the ſuperior power of natural cauſes in the extreme climates, ariſe the ſameneſs of ideas, and permanence of habit,

as the ſame regular cauſes muſt continue to produce the ſame uniform effects. The nations, as well as individuals of the temperate regions, are perpetually changing; and in the middle of this zone, where natural cauſes may be ſuppoſed to operate leaſt, nations have roſe to the greateſt glory, and ſunk to the oppoſite extreme; while thoſe who live near to, or within the torrid and frigid latitudes, whether civiliſed or ſavage, feel the powerful influence of phyſical cauſes, by which they are fixed to a perpetual and limited ſameneſs.

CHAP. IV.

Some Reflections on what hath been ſaid, and what is intended in the ſucceeding Chapters.

ALL writers, travellers, and philoſophers agree, that there is a real variety in the characters of nations; they

differ in opinion with reſpect to the cauſes of that variety only. In the preceding Chapters we have attempted to reconcile theſe oppoſite ſentiments from two facts, which are allowed by both parties, viz. that of ſimilarity in the inhabitants of the torrid and frigid zones; and their inferiority to thoſe of more temperate climates.

Although theſe facts are ſo generally allowed, yet no perſon (ſo far as we know) has attempted to trace the natural cauſes which produce this ſimilarity of the human ſpecies in theſe oppoſite extremes of climate, and their inferiority in both, to the ſame ſpecies in the middle latitudes. Dr. Ferguſon ſays, 'We are ſtill unable to explain the manner in which climate may affect the temperament, or foſter the genius of its inhabitants.'

Thoſe writers who have taken the ſide of moral cauſes, have endeavoured to inveſtigate

tigate the operation of theſe cauſes; but the advocates for the action of phyſical powers have been vague, unſyſtematic, and partial.

Baron Monteſquieu's experiment with a ſheep's tongue, and his reaſonings on climate in conſequence, are at beſt conjectural and general, and relate to heat and cold only as increaſing or diminiſhing ſenſibility; were his proofs extended, they would lead us to believe, that the inhabitants of the arctic circle are more bold than thoſe in the latitude of 50; but the contrary of this is a well-known fact.

In the Second Part of theſe Obſervations, we have endeavoured to ſhew how climate interferes with the health of the body, and preſcriptions of the phyſician. Here it is propoſed to extend the phyſical principles, which we have attempted to eſtabliſh in the Firſt and Second Parts, to mind as well

as body; by which we hope to render it highly probable, that the ſimilarity of the aborigines of the torrid and frigid zones reſults not only from natural cauſes, but from the prevalence of the ſame cauſe.

CHAP. V.

Of the Inhabitants of warm Climates.

BY the torrid zone, is meant that part of the globe which lies between the tropics; but in the diviſion of the earth which we at preſent adopt, the warm climates are extended to about the 30th degree north and ſouth; though the effects of a warm climate are no doubt decreaſing from the latitude of the tropics, which are the limits of the ſun's progreſs; yet as the countries ſituated between them and the 30th degree have ſo great a proportion of his influence, we conſider them as properly

perly falling within the title of this Chapter.

The Aborigines of the torrid zone, ſtrictly ſpeaking, may be divided into two kinds, viz. Indians and negroes.

On the north ſide of the equator, the firſt are a ſhort ſquat people, with broad faces, thick lips, flat or flattiſh noſes, long black hair, and ſkins more or leſs of a dark brown or yellow colour, varied by local cauſes; their countenances are dull, their bodies inactive, and their minds ſtupid and timid. The inhabitants of the Society and Friendly Iſlands who are ſituated within the 23d degree of ſouthern latitude are fairer and taller than the tropical Indians of the northern hemiſphere; their hair is alſo curled, and more reſembling that of Europeans.

An inſular ſituation muſt be favourable to this change, particularly when under

general cultivation, which is the caſe at Otaheite and the reſt of theſe iſlands; this not only keeps the air in a depurated ſtate by allowing the ſea winds to circulate freely over the land, but alſo ſupplies the inhabitants with a large proportion of vegetable food. Theſe cauſes muſt greatly counteract a putreſcent tendency, by which the colour of the ſkin will not only be improved, but the mental powers rendered more active.

In equal latitudes, the colds of the ſouthern hemiſphere are much greater than on the northern; from which we may conſider the inhabitants of the ſouth on a footing, in point of climate, with thoſe of the north, who are ſituated conſiderably nearer the pole*.

The

* In Chap. IX. of the Firſt Part a conjecture is offered on the cauſes of cold in the ſouthern hemiſphere being ſuperior to thoſe of the northern; it is there ſuppoſed, that the heat in any diſtrict of the globe will bear a certain proportion

The negroes are black, with very ſhort curled woolly hair, with thicker lips and flatter noſes than the Indians; they are in general a taller and better-made people, and poſſeſs more ſpirit, and rather better underſtandings; but are, however, like

tion to the quantity of phlogiſton diſengaged in that diſtrict. This now appears more probable, as by Dr. Crawford's Theory of Animal Heat, it has been ſhewn in the Second Part, that from atmoſpherical air abſolute or latent heat is decompoſed by the phlogiſton evolved in the body, and diſcharged through the lungs, which heat becomes ſenſible by the decompoſition. We apprehend the ſame decompoſition will take place wherever the phlogiſton in a diſengaged ſtate comes in contact with dephlogiſticated air; and hence we ſuppoſe, that on large tracts of land well clothed with vegetables, and ſtocked with animals, a greater proportion of phlogiſton is continually impregnating the air than on ſmall iſlands, and conſequently changing a greater proportion of heat from a latent to a ſenſible ſtate; hence an inſular ſituation is not only cooler than continents in the ſame latitude, by affording leſs phlogiſton to promote the decompoſition of heat, but is alſo more favourable to the diſcharge of this principle by the lungs. The rays of the ſun, which are the ſources of heat, generate or produce that heat in proportion to the perpendicularity of their direction, and that only when intercepted by bodies more or leſs opaque; hence, as mentioned in a former Chapter, much of their heat, or power of generating heat, is loſt in the ſeas which ſurround iſlands.

them,

them, lazy, dull in comprehenſion, ſullen, and naturally timid, though in a leſs degree than Indians. Neither of theſe people have much hair on their bodies, and few of them, particularly the Indians, have much beard.

From the tropic of Capricorn towards the ſouth, the aborigines of what is called South America, together with the inhabitants of New Holland, and thoſe of the Cape of Good Hope, are the only people we know any thing of who fall within the limits fixed in this Chapter.

Thoſe about Rio de Janeiro, and from thence to Rio Grande, ſituated from the 23d to the 30th degree ſouth, are induſtrious and active, and a much bolder and hardier people than the inhabitants of Paraguay, who are within the ſouthern tropic. The inhabitants of New Holland are ſaid

to

to be a dark-coloured people. This may probably ariſe from being much intermixed with the negroes of New Guinea. As to their particular diſpoſitions, little or nothing is known, though this vaſt country extends from the 10th to the 40th degree of ſouth latitude.

The Cape of Good Hope, or Hottentot country, runs from near the tropic to the 33d degree ſouth; and although its inhabitants are famous for their filth and want of improvement, yet they have naturally tolerably fair ſkins, and a conſiderable degree of induſtry and activity; they deteſt ſlavery, but ſerve the Dutch for wages; they breed ſheep and cattle, and cultivate the ſoil. Theſe are taſks to which the Aborigines between the tropics can never be brought but by force. In Africa, near the ſea-coaſt, ſome individuals have made feeble efforts towards improvements, when ſtimulated

lated by the example of Europeans, with whom they have much intercourſe in the way of trade.

When we come on the north ſide of the tropic of Cancer, the Indians are more hardy than thoſe of the torrid zone, yet they are more ſlothful and timid than thoſe further north. The inhabitants of Barbary are more active and bold than thoſe between the tropics, yet they are much inferior to the nations further north, in ability both of body and mind. A part of Perſia, the Mogul Empire, and a conſiderable proportion of China, are ſituated between the tropic and the 30th degree; theſe countries are famous for the ſoft timid turn of their inhabitants; and although ſome parts of them are much civilized, yet they do not poſſeſs that ſtrength either of body or mind, which hath always diſtinguiſhed the inhabitants of the more northern climates.

The

The Arabians are ſaid to be a brave people. This character may, in ſome degree, be accounted for, from the dry and barren, but healthful ſoil of Arabia Petræa, and Arabia Deſerta; which, together with the cuſtom of robbing, and being from infancy expoſed to danger, cannot fail to give them great advantages over their indolent neighbours. The people of Arabia Felix poſſeſs much leſs of this diſpoſition; they ſink under the influence of a vertical ſun, and remain ſecured from foreign attacks, by the ocean on three ſides, while the avenues to their country by land is guarded with deſarts, and their more active northern tribes, who extend themſelves over the Iſthmus of Suez and round the head of the Mediterranean ſea, as far as the 31ſt or 32d degree of north latitude.

CHAP.

CHAP. VI.

Of the Inhabitants of the Frigid Zone.

THE natives of this diſtrict of the globe are a ſhort, thick, ſquat people, with ſtraight black hair on their heads, and very little on their bodies, having exceeding little beard in advanced age; their noſes are flat, their lips thick, and their ſkins dark brown; in ſhort, they are in every reſpect ſimilar both in body and mind to the native Indians of the torrid zone, though rather leſs in ſtature *; they are equally lazy, ſtupid, and timid. Such are the Samojedes, Groenlanders, and Zemblians, and all who inhabit to the north of the arctic circle; but even eight or ten degrees, or more, ſouth of this line, theſe effects of climate are in ſome places diſcoverable, either on the bodies

* This difference reſults from the extreme rigidity produced by the exceſſive cold.

or

or in the minds of the inhabitants, which increaſe as we move north until they arive at the ſtrong marks above mentioned.

CHAP. VII.

Of the Inhabitants of the temperate Climates.

WE ſuppoſe the temperate climates to extend from the latitude of 30 to 65. The inhabitants of theſe two diſtricts, one on the northern, and the other on the ſouthern hemiſphere, are ſuperior to the nations of either the torrid or frigid zones, in form, complexion, temper, and vigour both of body and mind. On the ſouth ſide of the globe, there are no nations between the above latitudes, whom we are acquainted with, except the inhabitants of New Zealand, and ſome ſcattered tribes of Indians

Indians about the Terra Magellanica, and Terra del Fuego *. The New Zealanders are a well made, hardy, bold people †; and although little is known of the Magellanic inhabitants, yet there is enough to prove, that climate hath alſo its due effect there, as theſe Indians are much bolder and more warlike than thoſe of the tropical latitudes, or even thoſe who inhabit ſo far ſouth as the river La Plata, where they are neither without vivacity, nor a certain degree of ſpirit ‡; yet they have all ſubmitted to the Spaniſh yoke; while thoſe further ſouth ſtill keep their independence, and were even formidable, and helped to extirpate a co-

* The climate of the iſland of Terra del Fuego and the Straits, is ſo exceedingly ſevere, though far within the temperate zone, that its inhabitants reſemble more the Aborigines of the arctic circle, than thoſe of a more temperate region.

† See Capt. Cook's Voyages.

‡ See Sir Francis Drake's Voyages.

lony

lony from Old Spain, ſettled in the Straits of Magellan *.

When we come into the northern hemiſphere, we find all the nations of Europe, both antient and modern, who ever have made, or do now make, any figure in the world, ſituated between the latitudes of 30 and 65; to particulariſe them would be too hiſtorical for this place.

When we go into Aſia, there the ſame thing is evident; a part of China extends beyond the 40th degree, and from this northern part does the military ſtrength of that empire ariſe.

The Tartars, who run much further north, are a bold and hardy people; but ſuch of them as have removed into China,

* See Sir Thomas Cavendiſhe's Voyage round the World.

ſince the conqueſt of that empire, yield to the influence of its climate.

In America, the aborigines from the 30th to the 65th degree are a bold people, and much better made than thoſe of either the torrid or frigid zones, nor are they naturally wanting in mental qualities; yet it is even remarkable on this continent, that the Indians of Florida and Georgia at the ſouthern extremity, and thoſe about Hudſon's Bay at the northern, are leſs warlike, and in every reſpect inferior to thoſe ſituated between them.

CHAP.

CHAP. VIII.

The Effects of a putrescent Tendency in the human Body.

THAT the purity or phlogisticated state of the atmosphere we breathe, hath the greatest effect on our bodies when in health, as well as when afflicted with disease, must, we suppose, appear evident from the Second Part of these Observations. That the warmth of climate is productive of this impregnated state of the atmosphere, we apprehend cannot be doubted; for these reasons, and what shall hereafter be offered, we conclude, that the particular differences between the inhabitants of the torrid zone and those of the temperate climates, both in form of body and turn of mind, result from an habitual putrescent tendency with which their constitutions are loaded.

In the torrid zone the heat of the climate, and impregnated ſtate of the atmoſphere, give animal bodies a ſtrong propenſity to putrefaction, by which a more copious evolution of the phlogiſtic principle takes place. In the frigid zone we find the ſame prevalent tendency to putrefaction in a ſtill higher degree, reſulting from want of perſpiration and a continued animal diet; and to this greater exceſs of putreſcency from food and cold conjoined, we impute the diminiſhed ſize and flat diſagreeable countenances of theſe northern nations.

Putrefaction, in living animal bodies, is much increaſed in the hot latitudes by the impregnated ſtate of the atmoſphere, as in theſe countries the air is unable to free the body by the lungs from the putreſcent matter which is continually diſengaged; it therefore accumulates in a certain degree through the whole ſyſtem, and goes off by the

the ſkin more copiouſly than in colder climates, to which the colour of the body may probably be attributed, and alſo its particular form, and that peculiar diſpoſition of mind, which marks the natives of the tropical climates.

In the frigid zone the air is exceedingly favourable to the diſcharge by the lungs, as it is there dry and unimpregnated*, but the aliment of the inhabitants is animal, and moſtly fiſh. A diet of this kind co-operates with the want of perſpiration to bring on a general and ſtrong putreſcent tendency; therefore from theſe oppoſite external cauſes, viz. heat and cold, we find the ſame effects, for the internal heat of the human body is nearly the ſame in all climates.

The effects from theſe cauſes are in every reſpect ſo exactly ſimilar, as to leave no

* See Chap. XXVII. of the Second Part.

doubt of their reſulting from the ſame ſtate of body, however different the means of producing that ſtate originally were; as it muſt be remembered, that the ſame degree of putreſcency, induced by any cauſe whatever, is exactly productive of the ſame effects on both body and mind, whether from heat, cold, damp, food, or extreme relaxation.

A putreſcent tendency is the only point in which the inhabitants of the torrid and frigid zones are neceſſarily alike from circumſtances of climate, and this cauſe alone ſeems capable of regulating their external appearance, as well as mental faculties.

The inhabitants of the middle climates breathe an air, which, though not ſo much dephlogiſticated as that of the frigid zone, yet is vaſtly more ſo than the air of the warm latitudes; added to which, their perſpiration

ſpiration is, generally ſpeaking, ſufficiently plentiful, and the principal part of their food is vegetable.

From theſe united cauſes ariſe the leſs habitual putreſcent tendency of the inhabitants of the middle climates, by which a much leſs proportion of phlogiſton is diſcharged through the ſkin; and in conſequence the colour and appearances of body, and faculties of mind, of the nations of the middle regions, are as widely different from thoſe of the torrid and frigid zones, as the climates which produce and nouriſh them.

CHAP. IX.

A putreſcent Tendency from Diſeaſe gives the ſame Appearances and Turn of Mind which are natural to the Inhabitants of the Torrid and Frigid Zones.

THE ſcurvy is a general putreſcent tendency of the body. Thoſe who begin to be afflicted with this diſeaſe become of a pale wan colour, and of a dull, inactive, melancholy diſpoſition. When the diſeaſe increaſes, it is with difficulty they can be made to perform the ſmalleſt exertions; the ſkin becomes darker, and the reluctance to motion increaſes in proportion to the progreſs of the putreſcent tendency.

Conſumptions are alſo from a putreſcent cauſe. Dulneſs, oppreſſion, and even melancholy, are ſymptoms of this malady. When the

the tendency is diffuſed through the whole body, the ſkin is generally pale, and often ſwarthy, accompanied with great diſlike to exerciſe. Putrid fevers do in the ſame manner darken the ſkin, and give the ſame dull, inactive turn of mind.

By thus finding that all cauſes which induce a general putreſcent tendency in the body, do produce the ſame appearances and effects in proportion to their degree, which reſult from the extremes of climates and animal food, we are thereby led to conſider the above reaſoning ſtrongly confirmed.

CHAP.

CHAP. X.

Some Reflections reſpecting the Cauſe of Swarthineſs in the Savages of the Middle Climates.

THE food of theſe uncivilized nations is moſtly animal, the effect of which is much increaſed by the damp impregnated atmoſphere of the woody countries they inhabit. This ſtate of the air prevents a free diſcharge both by the lungs and ſkin. The diminution of theſe diſcharges muſt give a putreſcent tendency; and if we add the continual expoſure of body to all the viciſſitudes of ſeaſon and inclemencies of weather, we ſhall find, that though the underſtandings of theſe people are quicker, and their bodies better ſhaped and ſtronger, with minds more firm and hardy,

hardy, than thoſe of either the torrid or frigid zones; yet the natural cauſes which exiſt in woody countries, together with their manner of living, are ſufficient to make a wide difference between them and the civilized nations of the ſame latitudes, whoſe food by the cultivation of ſoil is different, and whoſe bodies are clothed and protected from the rigour of the ſeaſons; which in fact is, in ſome degree, altering the climate, by having and uſing theſe means which ſubdue its too violent effects.

CHAP. XI.

Why Negroes poſſeſs more Activity than Indians of the Torrid Zone.

IN the Firſt Chapter of this Part, it is obſerved that negroes have a degree of ſpirit and appearance ſuperior to the Indians

of the torrid zone, and this ſuperiority has always manifeſted itſelf when conteſts have happened between them*. The cauſe from which this difference originates ſeems difficult to inveſtigate; the following conjecture, founded on the facts we are about to mention, afford a probable ſolution.

In the formation of negroes, there ſeems to be an original peculiarity in the reticular covering of the body immediately under the epidermis, called Rete Mucoſum; it gives the black colour to the ſkin, and when by ſcalding or burning this ſubſtance is deſtroyed, the new ſkin becomes white. The hair of the human body hath a bulbous

* Many inſtances might be given of this in the Dutch ſettlements of Surinam, Iſaac Cape, &c. on their American continent, but the following is one in our own colonies:

On the coaſt of St. Vincent, about fifty or ſixty years ago, an African ſhip was wrecked; the negroes ſoon got the better of the brown Indians or aborigines, and have in a manner extirpated them, and remain in poſſeſſion of their country.

root,

root, which muſt draw part of its nouriſhment from this reticular covering; and as that of negroes is ſo very different from the reſt of mankind, it may be ſuppoſed to derive its peculiarities from this ſource of its growth. Inſtances are not wanting of negroes born either without this reticular ſubſtance, or with it very tranſparent. Such are in the Weſt-Indies called improperly white negroes; their ſkins are of a cadaverous pale colour, and eyes too tender to bear the light of day; they are generally delicate, ſtupid, and unfit for ſervice; their hair is alſo of a whitiſh colour, and neither ſo hard nor ſhort as that of blacks.

Theſe may be conſidered as *luſi naturæ*, for they are manifeſtly different from their parents; and the want of the black colour in the rete mucoſum (or rather of theſe properties, whether in conſtruction or otherwiſe, which give the black colour) ſeems to be

be attended with the conſequences above mentioned, viz. delicacy, ſtupidity, and unfitneſs for action.

The perſpiration of negroes is of a ſtrong pungent alcaline odour, which ſeems to ariſe from ſome peculiar property or power in the reticular covering which gives colour to the ſkin. This extraordinary phlogiſticated perſpiration, ſo remarkable in blacks, we ſuppoſe, depends on the powers of ſecretion in the rete mucoſum, by which the putreſcent matter is more copiouſly diſcharged from the ſurface of the body; and undoubtedly a more free diſcharge of the putreſcent effluvium by the ſkin, may not only liberate the conſtitution in a certain degree, but tend to produce that very blackneſs in the rete mucoſum itſelf.

From theſe very diſtinguiſhing external marks, negroes ſeem a peculiar variety of the

the human ſpecies, better fitted by nature than thoſe of fair complexions to diſcharge by the pores of the ſkin the phlogiſton evolved from their bodies, and conſequently are much better adapted to the warm climates. If blackneſs of ſkin were acquirable, like that of brown, by a long continued habitual putreſcency, the inhabitants of Groenland and Nova Zembla ſhould be black, and their hair ſhort and curled, as they are more in this ſtate than the aborigines of hot climates; yet the colour of their ſkin is only dark brown, and does not affect the growth of their hair, which is long, ſtraight, and black.

Sir John Pringle, in his experiments on blood, found that the craſſamentum after allowed to become putrid, being mixed with water, gave it, as he himſelf expreſſes it, a tawny hue. This is in favour of our opinion relative to the colour of Indians.

Theſe

Theſe people, both in the torrid and frigid zones, as well as the ſavages of the temperate latitudes, appear the ſame with the inhabitants of the middle climates, and only changed by the cauſes we have mentioned; and it is probable, that a removal to the middle latitudes would, in a few generations, bring them to a better colour, form, and underſtanding.

CHAP. XII.

The Effect of clearing woody damp Countries.

THE air of all woody countries, particularly if flat, is more damp and phlogiſticated than the air of the ſame country is when cleared of its woods. In the Firſt Part we have conſidered vegetation as depurating phlogiſticated air, and rendering

rendering it fit for animal reſpiration; it may therefore ſeem contradictory to ſay, that the air of woody countries is always more phlogiſticated than the air of the ſame country would be, were it cleared of its woods.

There is no doubt that ſhort vegetables and ſcattered trees, through which the rays of the ſun penetrate, and the air circulates freely, muſt tend to purify the atmoſphere, and make it more ſerviceable to animal life; but we muſt conſider that the countries now alluded to are covered with a cloſe woody coat, through which the rays of the ſun never penetrate to the ſurface of the earth; and conſequently that the power of theſe trees, in purifying the atmoſphere, is confined to their tops, on which only the rays of light can act, while the air retained under them is little agitated, and ſeldom changed, and is continually receiving freſh

impregnations from decaying trees and rotting leaves which daily fall to the ground; and were it not for the great depuration of the air which takes place in the upper parts of the trees, by which its gravity is increaſed, and therefore muſt be continually falling towards the earth, while the impregnated air is conſtantly aſcending, cloſe woody countries would, we apprehend, be unfit for the purpoſes of reſpiration.

The continent of North America is vaſtly extenſive and flat; it was totally covered with woods, and interſperſed with lakes, rivers, and moraſſes, all of which contributed to keep the air in a ſtagnated, damp, and high impregnated ſtate.

Lightning, even a great way north, was then moſt frequent and general, which ſhewed its atmoſphere to be highly charged with phlogiſton.

When

When we conſider in how great a degree theſe cauſes exiſted before cultivation made any progreſs on that continent, we may diſcern ſufficient grounds, upon our principles, for both the colour and turn of mind of the Aborigines of that vaſt country.

At this time the ſurface being much cleared, lightning has become leſs frequent, the air is more pure, dry, and dephlogiſticated; vegetation is alſo become leſs luxuriant in theſe cleared parts of the country, which is, we apprehend, as much the effect of a depurated and changed atmoſphere, as of exhauſted ſoil. Putrid diſeaſes are, in conſequence of theſe alterations, leſs frequent, rapid, and dangerous than formerly.

The European inhabitants who were tranſplanted to that continent, ſeemed for a time to degenerate; but the face of the country, being by degrees changed from woods and

moraſſes to a clear ſurface and cultivated fields, and conſequently from an impregnated to a pure atmoſphere. Thoſe appearances have ſubſided, and the natural effects have begun to flow from theſe changes, which there was every reaſon to expect from its cultivation and climate; and the more quickly it is deprived of its woody covering, the more rapid will its improvements be in every thing that hath diſtinguiſhed the European nations in equal latitudes.

CHAP. XIII.

That Slavery appears neceſſary to the Agriculture of very hot and very cold Climates.

FROM the natural effects of climate in the torrid zone, we have ſeen that the inhabitants were, to the laſt degree, ſlothful, and had they never been viſited by Europeans, they would have, probably to this

this day, remained in their original indolence. The great Baron Monteſquieu, in his Spirit of Laws, ſays, the more the phyſical cauſes make mankind inactive, the more ſhould the moral ones be calculated to counteract them. This rule ſeems exceedingly juſt; and we ſhall concur with him ſtill more ſtrongly, when we find, from experience, that example will not produce the exertions in theſe climates, which are neceſſary for agriculture, ſociety, and civilization.

The iſland of Tobago was depopulated, after being far advanced in its cultivation by the Dutch; yet neither the native Indians who remained on the iſland, nor thoſe more numerous tribes on the iſland of Trinidad, who daily viſited it, ever thought of following the example of the induſtrious expelled inhabitants, or of even making any advantage of the improvements they

left behind; their buildings fell to pieces, and the ſurface was ſoon again covered with woods.

The free negroes*, or black Indians, as they are called, as well as the real brown Indians, or Aborigines of the iſland of St. Vincent, lived on friendly terms for a great number of years, before the cloſe of laſt war, with the few French who were ſettled there; yet they never attempted the ſmalleſt improvement, in imitation of thoſe which were daily carrying on in their view by the French.

Theſe, and many other inſtances of a like kind may be given to ſhew, that in very warm climates, the ſtrongeſt ſtimuli to the human mind are incapable of produc-

* Theſe people were brought from Africa about fifty odd years ago, by a ſhip which was wrecked on the iſland of St. Vincent.

ing

ing mental activity, and that nothing under abſolute neceſſity will force to bodily exertion *.

Slavery, and the authority reſulting from it, ſeem therefore in a certain degree neceſſary to counteract the natural cauſes of inactivity in the hot latitudes. If liberty there was univerſal, it would be ſo far from producing thoſe good effects which ſome ingenious writers on ſociety and juriſprudence have imagined, that the moſt op-

* Many quotations might be brought from the Spirit of Laws, which bear ſtrong relation to this ſubject, but we ſhall content ourſelves with the following:

'La chaleur du climat peut être ſi exceſſive que le corps 'y ſera abſolument ſans force. Pour lors l'abattement paſ-'ſera à l'eſprit même; aucune curioſite, aucune noble en-'trepriſe, aucune ſentiment généreux; les inclinations y 'ſeront toutes paſſives, la pareſſe y ſera le bonheur; la 'plûpart de chatimens y ſeront moins difficiles à ſoutenir, 'que l'action de l'ame, & la ſervitude moins inſupportable, 'que la force d'eſprit qui eſt neceſſaire pour ſe conduire 'ſoi-même.'

De l'Eſprit des Loix, tome ii. chapitre z.

poſite conſequences would take place; the inhabitants would ſink into ſloth, and the ſurface would ſoon again become clothed with ſpontaneous productions; no further exertions would be made than what were neceſſary to anſwer the urgent demands of nature; and thus, by attempting to eſtabliſh cuſtoms and laws, which too much coincide with the natural tendency of climate, we ſhould add to its influence, and produce conſequences diametrically oppoſite to thoſe propoſed.

In the courſe of the foregoing Chapters, we have endeavoured to make it appear, that the ſame effects on both body and mind reſult from exceeding cold climates, which ariſe from very hot ones; the natural cauſes therefore in thoſe latitudes, ſhould alſo be counteracted by the moral ones.

In Poland, Ruſſia, Hungary, &c. the climates are ſufficiently cold, to produce in a certain degree the prevalent diſpoſition of the frigid zone; and conſequently, the peaſantry of theſe northern kingdoms are ſubject to the ſcurvy, ſtupid, void of curioſity, and ſlothful almoſt to the laſt degree. Here that authority which reſults from ſlavery becomes as neceſſary as in the torrid zone, and did it not actually take place, the ſoil would in a great meaſure be neglected; and although their inactivity could not be ſo exceſſive as thoſe people who inhabit beyond the arctic circle, yet it might be ſufficient, were they in a ſtate of abſolute freedom, almoſt totally to obſtruct the progreſs of agriculture, civilization, and refinement.

The people of ſuperior rank in thoſe nations, from a different mode of living, good and warm clothing, and due protection from

from the rigours of their climate*, are poſſeſſed of that activity of mind, which is neceſſary to gain ſuperiority over the inferior ranks. The taſte which they acquire from more enlarged underſtandings, and the example of more ſouthern nations, all concur to make them exert that authority over their dependents, which is neceſſary to produce the requiſite exertions on their parts; hence it ſeems demonſtrable from the action of natural cauſes, that ſlavery is in a certain degree as neceſſary to the improvement of ſome countries, as liberty is to that of others.

* Warm clothes and ſtoves are the luxuries of Ruſſia, as well as the neceſſary precautions to prevent a too great ſuppreſſion of perſpiration. When a peaſant comes from many hundred miles diſtance to Peterſburg, inſtead of going about the ſtreets to ſatisfy his curioſity, he goes to enjoy himſelf in one of theſe ſtoves or hot-beds, and does not diſcover the leaſt ſurpriſe, or wiſh to be better acquainted with the particulars of any thing in the capital.

Amongſt

Amongſt the inhabitants to the north of the arctic circle, who live in a ſavage ſtate, nothing of this kind is neceſſary, as they have little labour to perform, and their powers being more cramped by the influence of food and climate, which act ſo generally alike on all, that none are fitted to make ſuch ſuperior exertions, as can enable them to acquire and ſupport any degree of power, further than that which ariſes from bodily ſtrength; and from this ſuperiority alone ſeems to reſult the ſlavery of women among all ſavage nations; the extreme inſenſibility of theſe people, and abhorrence of exertion, from the cauſes we have mentioned, make the men the tyrants of their families, by inflicting the whole labour on thoſe over whom they have power; and this degree of ſuperiority ſeems as neceſſary to make the women perform the drudgery of their ſtation, as the power of maſters over their ſlaves, in the civilized

parts

parts of very hot or very cold countries.

By the writers we have alluded to, it is generally alleged that no people will work with ſatisfaction but ſuch as are to enjoy the immediate and entire benefit of their own labours.

This allegation ſeems plauſible, and to every mind poſſeſſed of a certain degree of knowledge and activity, is perfectly concluſive when applied to itſelf; but it muſt be obſerved, that to give it general weight, we preſuppoſe a degree of mental ſenſibility, which does not generally exiſt in the human race; and without that certain degree of it, which is not to be met with in the Aborigines of either the torrid or frigid zones, theſe arguments fall to the ground.

Whether the conduct of the inhabitants of the temperate climates, in forcing thoſe of

of the torrid zone from their natural indolence and ſtupor into a ſtate of greater activity, or whether thoſe of ſuperior ranks in the northern kingdoms who do the ſame, are culpable or not, we leave to be determined by others; but it appears to us, if cultivation and improvements are to be proſecuted in theſe climates, ſlavery, to a certain degree, is indiſpenſably neceſſary. This is confirmed by obſerving, that the improvements on the coaſt of Africa were made by ſlaves; and little as they are, it is probable that nothing would have been done, had ſlavery not exiſted among the natives. From the voyages of Capt. Cook, ſlavery exiſts in the Friendly and Society Iſlands, which are ſituated between the 15th to the 23d degrees of ſouth latitude, to this circumſtance they ſeem to owe their cultivation; as no improvements are to be found in the tropical latitudes, where the ſuperiority reſulting from ſlavery does not take place.

CHAP.

CHAP. XIV.

The temperate Regions proper for Freedom.

ALTHOUGH we have extended the temperate climates from the 30th to the 65th degree only, yet (as hath been obſerved in a former Chapter) theſe cauſes which exiſt in their full force to the north of the arctic circle, may be found to a certain extent, in different places as far as eight, or even ten degrees ſouth of that circle, or perhaps, from particular local circumſtances, even ſtill further*; but it is undoubted, that in the middle climates, among civilized nations, none of theſe effects are produced by either food or air, which we have pointed out, as the cauſes of form, colour, and diſpoſition in the

* The miſerable inhabitants of the Terra del Fuego are an example of this ſort.

two

two extremes ; the body is therefore at all times in a leſs putreſcent ſtate, and conſequently more active and vigorous, and the mind, from the ſame cauſe, becomes more quick to comprehend, and more bold to execute ; ſlavery therefore is not only not neceſſary in the temperate climates to force exertions, but the very idea is generally held in abhorrence ; and although from revolutions a temporary ſlavery may take place in any country, yet its duration cannot be long where climate does not concur to ſoften and ſtupify the intellectual powers.

The natural activity of body and mind, which the inhabitants of the middle diſtricts of the globe poſſeſs, renders them ſufficiently ſenſible of every ſtimulus to action ; and in particular countries where a pure air is aſſiſted by a due degree of perſpiration and proper food, the inhabitants are ſometimes too ſuſceptible of impreſſions, and

over-prompt to action; while in others, from a more flat, moiſt ſurface, conſequently a more humid impregnated atmoſphere, and leſs perſpiration, the inhabitants are leſs active in body, and leſs quick in comprehending and executing.

There are a great variety of characters amongſt the different nations in the temperate regions, and even many ſubdiviſions in different parts of the ſame nation; but we ſhall not attempt deſcending into theſe particulars, as it is ſuppoſed the general principles laid down will apply when duly examined and eſtimated, and proper allowances made for the alterations on the ſurfaces of countries at different periods, and the concurrence or counteraction of moral cauſes in each period and place.

THE END.

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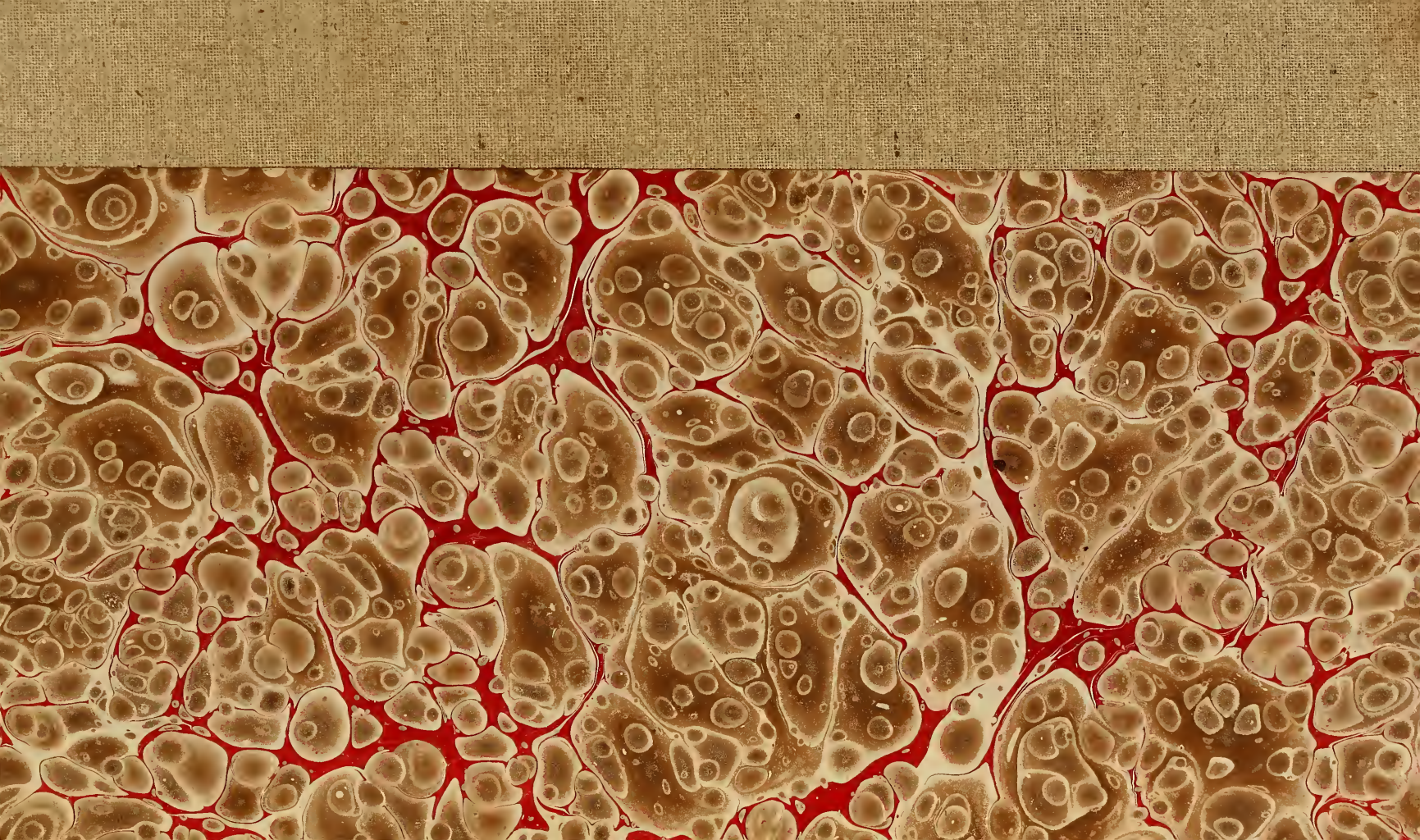
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